PB88-106455

Superfund Record of Decision (EPA Region 3) West Virginia Ordnance Works Mason County, West Virginia, March 1987 First Remedial Action

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March 1987

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EPA

Superfund Record of Decision:

West Virginia Ordnance, WV

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16. ABSTRACT

The West Virginia Ordnance Works (WVOW) site covers approximately 8,323 acres in Mason County, West Virginia. In 1942, WVOW was established as a government-owned, contractor-operated plant for the manufacture of trinitrotoluene explosives (TNT). Approximately one-third of the area is currently occupied by the McClintic Wildlife Station which is operated by the West Virginia Department of Natural Resources (DNR). Smaller portions of the nonindustrial areas of the site were declared excess and sold. They are now owned by Mason County or by private owners. TNT was produced from 1942-1945 by a batch process involving the nitration of toluene by the addition of nitric acid and sulfuric acid. Production during World War II resulted in soil contamination of the industrial area, process facilities, and industrial waste water disposal facilities by TNT, associated by products, and environmental transformation products. At the close of operations in 1945, WVOW was decontaminated by the Department of Defense and placed on standby status. Later that year, the plant was declared surplus and the facilities salvaged or disposed of. Contaminated media include: surface and subsurface soils, industrial sewer lines; underlying shallow aquifer of the TNT manufacturing area; trunk sewer lines leading from Pond 13 to outfalls; surface water and sediments of Pond 13; surface soils in the East and West Burning Grounds; soils/sediments which eroded from the contaminated sources. The primary contaminants of
(See Attached Sheet)

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision West Virginia Ordnance Works, WV First Remedial Action Contaminated Media: soils, sediments, sw, gw Key contaminants: nitroaromatic residues, 2,4,6-TNT, 1,3,5-TNB, 2,4-DNT, asbestos		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report) None	21. NO. OF PAGES 8
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West Virginia Ordnance Work, WV

16. ABSTRACT (continued)

concern include: nitroaromatic residues, 2,4,6-TNT, 1,3,5-TNB, 2,4-DNT and asbestos.

In January 1986, EPA and DOD mutually agreed to divide subsequent studies at the site into two operable units. The selected remedial action for the first operable unit includes: in-situ flaming of the reactive TNT residue on the surface of the Burning Grounds Area followed by the installation of a 2 ft. soil cover (1.5 ft. clay and 5 ft. soil) over areas with greater than 50 ppm total nitroaromatics contamination; installation of a 2 ft. soil cover over areas in the TNT Manufacturing Area with greater than 50 ppm total nitroaromatics contamination; disposal of asbestos from the Burning Grounds Area at an offsite facility to be identified during design; excavation, flushing, and backfilling of the reactive sewerlines in the trenches from which they were removed. All contaminated soils exceeding 50 ppm at the surface will be covered to achieve the 10^{-6} risk level. The sewerline will be rendered unreactive by flashing and buried deeper than 2 ft. below ground surface; and assessment of the wetlands to be performed, prior to construction activities.

The estimated capital cost for this remedy is $1,807,000. O&M costs were not provided.

ATTENTION

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RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION
FOR FIRST OPERABLE UNIT

SITE: West Virginia Ordnance Works, Mason County, West Virginia

DOCUMENTS REVIEWED

This decision is based primarily on the following documents describing the analysis of the cost and effectiveness of remedial alternatives for the West Virginia Ordnance Works:

- West Virginia Ordnance Works Remedial Investigation (Environmental Science and Engineering, Inc., March 1986). Report No. AMXTH-IR-CR87004

- West Virginia Ordnance Works Feasibility Study for the TNT Manufacturing Area, the Burning Grounds, and the Industrial Sewer lines (Environmental Science and Engineering, Inc., October 1986). Report No. AMXTH-IR-CR87006

- West Virginia Ordnance Works: Endangerment Assessment for Sewer lines, the TNT Manufacturing Area, and the Burning Grounds (Environmental Science and Engineering, Inc., June 1986). Report No. AMXTH-IR-CR87005

- West Virginia Ordnance Works Environmental Survey Final Management Plan A004 (Environmental Science and Engineering, Inc., November 1984).

- Archives Search Report of the Former West Virginia Ordnance Works, Point Pleasant, WV (Environmental Science and Engineering, Inc., August 1984). Report No. DRXTH-AS-IA-A001

- Responsiveness Summary

- Interagency Agreement

- Meeting with West Virginia Department of Natural Resources

- Meetings with technical staff of Department of Defense (DOD).

- Environmental Protection Agency (EPA) internal staff reviews.

DESCRIPTION OF SELECTED REMEDY

An operable unit remedy for source control to include:

1. In situ flaming of the reactive TNT residue on the surface of the Burning Grounds Area,

2. Installation of a 2 ft. soil cover over areas in the Burning Ground Area with greater than 50 ppm total nitroaromatics contamination.

3. Installation of a 2 ft. soil cover over areas in the TNT Manufacturing Area with greater than 50 ppm total nitroaromatics contamination.

4. Asbestos from the Burning Grounds Area will be disposed of in an offsite sanitary landfill.

5. Reactive sewer lines will be excavated, flashed, and backfilled in the trenches from which they were removed.

6. A health and safety plan will be implemented for all activities described in this Record of Decision. During excavation, flashing and construction activities air monitoring will be conducted to ensure the safety of the onsite workers as well as to protect the residents and wildlife living nearby the construction areas.

7. A Wetlands Assessment will be performed, before construction activities to delineate potential wetland boundaries and identify wetland functions and values in the areas where remedial actions are to be taken. Impacts to wetlands will be avoided. Where no other practical alternative exists, impacts to wetlands will be mitigated.

The DA is currently conducting an additional Remedial Investigation/ Feasibility Study to evaluate the second operable unit at WVOW. The second operable unit consists of the Red Water Reservoir, Acids Area/ Yellow Water Reservoir and Pond 13 Areas. A Record of Decision will be prepared for the subsequent operable unit(s).

DECLARATIONS

Consistent with the Comprehensive Environmental Response Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Contingency Plan (40 CFR Part 300), we have determined that the remedial action described above, together with proper operation and maintenance, constitute a cost-effective remedy which mitigates and minimizes damage to public health, welfare, and the environment. The remedial action does not affect or violate any floodplain. The State of West Virginia has been consulted and agrees with the approved remedy. These activities will be considered part of the approved action. Based on discussions between EPA and the Department of Army (DA), an Interagency Agreement has been developed between the Agencies in which it is agreed that the DA will design and implement the selected remedy.

We have determined that the action being taken is a cost-effective treatment alternative, which reduces the volume of waste and provides a permanent solution to the maximum extent practicable, when compared to the other remedial options reviewed. We have also determined that although the contamination is not totally eliminated the criteria established for clean up will protect public health, welfare and the environment. Furthermore due to the deed restrictions which exist at this particular site, there is little potential for industrial or residential development in the areas of remedial action. In addition, the off-site disposal of asbestos to a sanitary landfill is more cost-effective than other remedial action alternatives and is necessary to protect public health, welfare or the environment.

March 27, 1987
DATE

James M. Seif
Regional Administrator
EPA Region III

4/3/87
DATE

Lewis D. Walker
Lewis D. Walker, Deputy for
Environment, Safety and
Occupational Health
Office of the Assistant Secretary
of the Army (Installations
and Logistics)

Summary of Remedial Alternative Selection for First Operable Unit At West Virginia Ordnance Works

Site Description

The West Virginia Ordnance Works (WVOW) site covers approximately 8,323 acres in Mason County, West Virginia. It is approximately 58 miles (mi) northwest of Charleston, 41 mi northeast of Huntington, and 6 mi north of Point Pleasant, WV, on the east bank of the Ohio River. Approximately one-third of the area is currently occupied by the Clifton F. McClintic State Wildlife Station (McClintic Wildlife Station), which is 2,788 acres in size and operated by the West Virginia Department of Natural Resources (DNR).

From 1942 to 1945, WVOW operated to produce trinitrotoluene (TNT) explosive. Production of this material during World War II resulted in contamination of the soils of the industrial area, process facilities, and industrial wastewater disposal facilities by TNT and associated byproducts and environmental transformation products. TNT was shipped to various Government installations to be loaded into munitions or for other uses. No loading of munitions or testing of ordnance was conducted at WVOW.

At the close of operations in 1945, WVOW was decontaminated to place it in standby status. Later in 1945 the plant was declared surplus and the facilities salvaged or disposed of. No records currently exist regarding the general extent of this decontamination. The industrial portion of the site was deeded to the State of West Virginia, with the stipulation that the site be used for wildlife management. If the land were to be used for any other purpose, or in the event of national emergency, the ownership of the land would revert to the Federal Government. The land, now owned by the state, currently comprises the McClintic Wildlife Station and is managed by the West Virginia DNR. West Virginia DNR's management practices are primarily designed to promote wetlands habitats and populations of resident and migratory waterfowl. Consistent with this objective, more than 30 shallow ponds have been constructed since cessation of military activities on the site, and most of the ponds are stocked with bass and catfish. The area is open for public hunting and fishing. Smaller portions of the nonindustrial areas of the site were declared excess by the Government, sold, and are now owned by Mason County, WV, or by private owners.

In May 1981, a seepage of red water was observed adjacent to Pond 13 located on the McClintic Wildlife Station. This pond is located near the former TNT wastewater trunk sewerlines and pumping station. This incident was investigated by West Virginia DNR and the U.S. Environmental Protection Agency (EPA). The shallow ground water discharging to Pond 13 was found to be contaminated by 2,4-dinitrotoluene (2,4-DNT) (up to 7,100 micrograms per liter (ug/L)), 2,6-dinitrotoluene (2,6-DNT) (1,300 ug/L), 2,4,6-TNT (166 ug/L in one sample), and phenol (31 ug/L).

Based on these and other studies by West Virginia DNR and EPA in 1981 and 1982, WVOW has been ranked as the 84th site on the National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (PL 96-510 amended by PL 97-272).

SITE HISTORY

WVOW was established in 1942 as a Government-owned, contractor-operated plant for the manufacture of TNT from toluene (Fig 1). General Chemical Defense Corp. of New York (a subsidiary of General Chemical Co., NY, which, in turn, was a subsidiary of Allied Chemical and Dye Corp.) operated the plant under contract. Prior to establishment of the plant, the major land uses were cropland (approximately 50 percent of the area), forest, pasture, and approximately 30 farm residences. Camp Conley, a West Virginia National Guard site established in 1927, was included in the acquisition for the plant.

From 1942 to 1945, WVOW operated to produce trinitrotoluene explosive (TNT), which is the common name for the compound 2,4,6-trinitrotoluene (2,4,6-TNT). Production of this material during World War II (WWII) resulted in contamination of the soils of the industrial area, process facilities, and industrial wastewater disposal facilities by TNT and associated byproducts and environmental transformation products. TNT was shipped to various Government installations to be loaded into munitions or for other uses. No loading of munitions or testing of ordnance was conducted at WVOW. Table 1 provides a summary of contaminants and concentrations for the three (3) source areas evaluated in this operable unit as well as associated off-site media.

Twelve TNT process lines were installed in the TNT Manufacturing Area, shown in Fig. 2, of which only Lines 1 through 10 were reportedly operated. Lines 8, 9, and 10 had been partially decontaminated in the 1950s by the Department of Defense (DOD). TNT was produced by a batch process involving the nitration of toluene by the addition of nitric acid and sulfuric acid.

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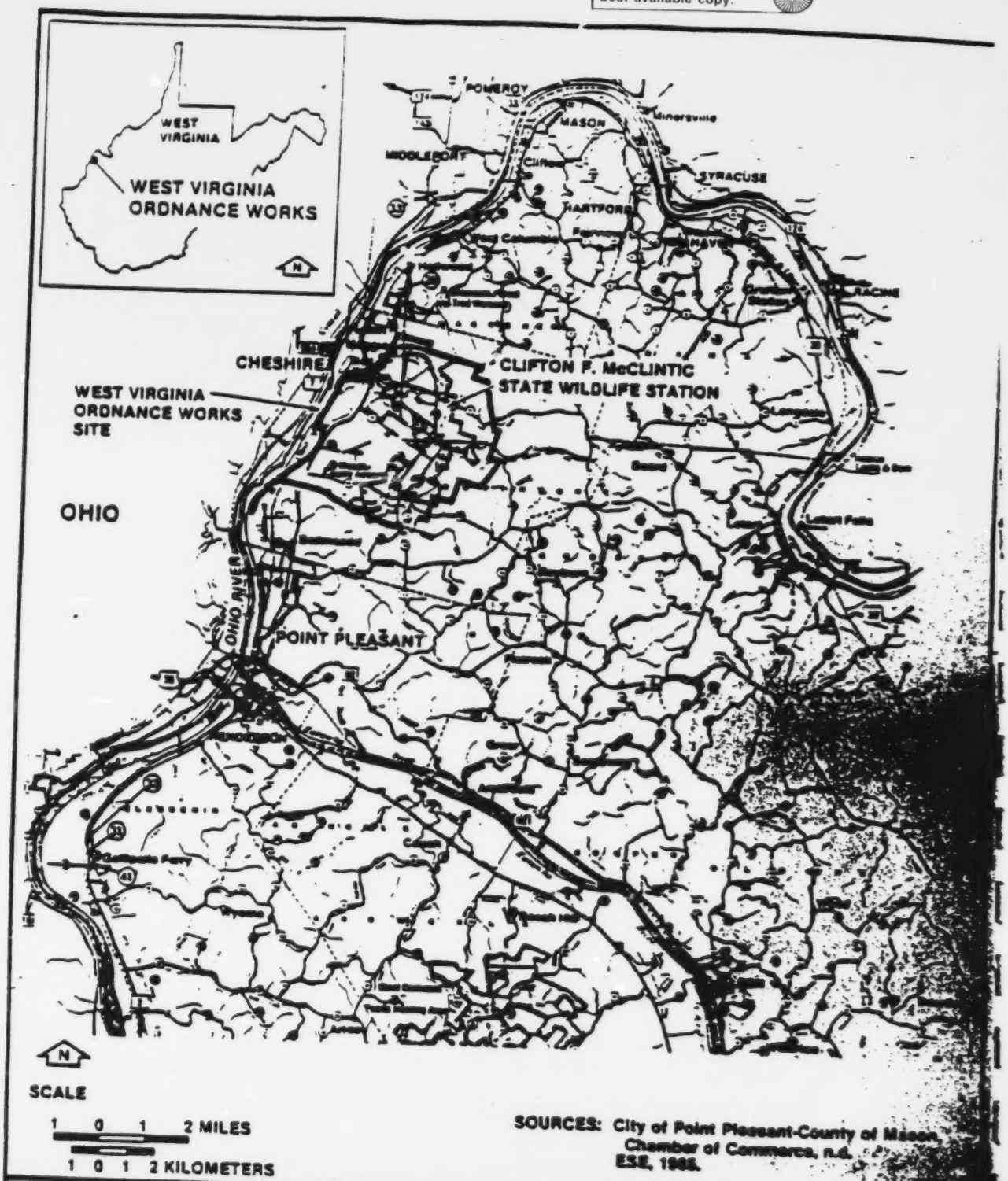

Figure 1 Page 3
LOCATION OF THE WVOW SITE

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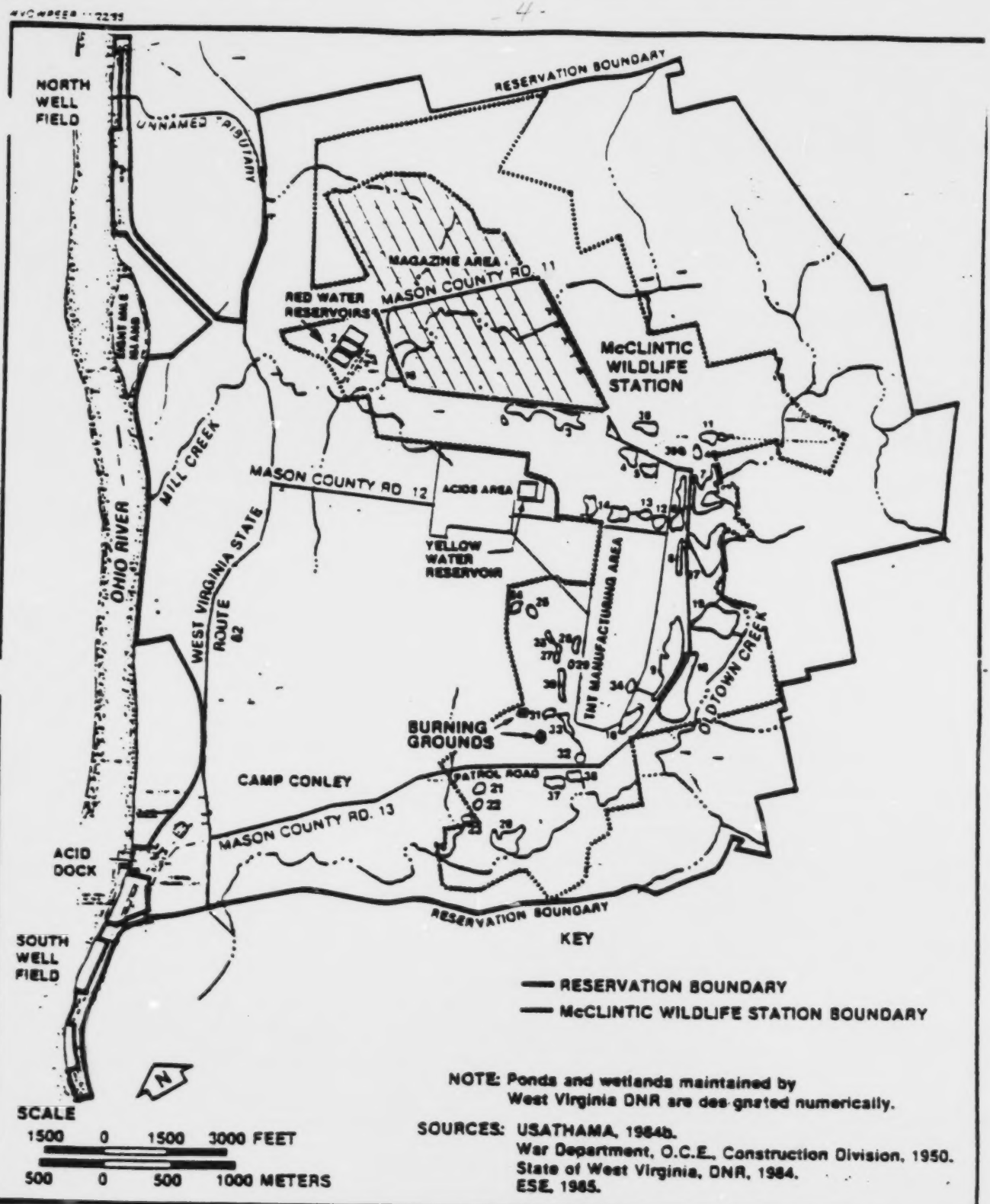

Figure 2, Page 4
SITE MAP OF WVOW (1942-1945)

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Table 1 Summary of Contamination Status for WVOW

Environmental Medium	Contaminant	Concentration Detected
TNT Manufacturing Area		
Soils	Nitroaromatics	3%
	Lead	320 ug/g
Surface Water	Nitroaromatics	1 ug/L (Pond 34 only)
Sediments	Nitroaromatics	0.4 ug/g
Ground Water	Nitroaromatics	14,000 ug/L
	Lead	20 ug/L
Burning Grounds Area		
Soils	Nitroaromatics	2%
	Lead	1,400 ug/g
	PAHs	100 ug/g
	Friable asbestos	Observed
Surface Water	Lead	20.5 ug/L
	Asbestos	2.6×10^6 fibers/L
Sediments	Lead	31 ug/g
Ground Water	Uncontaminated	—
Industrial Sewerlines		
TNT Manufacturing Area	Nitroaromatics	71%
Acids Area/Yellow Water Reservoir	Nitroaromatics	400 ug/g
Red Water Reservoirs	Nitroaromatics	0.2%
Pond 13/Wet Well Area	Uncontaminated	—

Table 1. Summary of Contamination Status for WVOW
(Continued, Page 2 of 2)

Environmental Medium	Contaminant	Maximum Concentration Detected
Offsite Areas		
Soils	Uncontaminated	—
Surface Water	Asbestos	480,000 fibers
Sediments	Uncontaminated	—
Ground Water	Uncontaminated	--

NOTE: fibers/L = fibers per liter
PAHs = polynuclear aromatic hydrocarbons
ft2 = square feet
ug/g = micrograms per gram
ug/L = micrograms per liter

Red and yellow water are liquid wastes produced during the TNT manufacturing process. Yellow water was discharged to the Mill Creek drainage system, which eventually drains into the Ohio River; red water was discharged directly to the Ohio River through a pipe located about 100 feet (ft) offshore. Retention ponds shown as the Red Water Reservoirs and Yellow Water Reservoir in Fig. 2. were constructed to regulate the discharge of red and yellow water to the river. Off-specification TNT was taken to the Burning Grounds (see Fig. 2.) for destruction by burning. Surface and subsurface soils and groundwater in areas of WVOW are still contaminated with nitroaromatic residues. In addition, a potential exists for contamination of other areas due to post-operation contaminant migration. At the close of operations in 1945, WVOW was decontaminated by DOD and placed in standby status. Later in 1945 the plant was declared surplus and the facilities salvaged or disposed of. No records currently exist regarding the general extent of this decontamination. Because the industrial area was contaminated to the extent that complete decontamination was not feasible, a portion of the land was not released to private ownership but was transferred to the State of West Virginia for wildlife conservation. This area of the site, including the industrial area, forms the McClintic Wildlife Station.

Subsequently, limited industrial activity has occurred at the WVOW site. Activities which have occurred and which potentially contribute or contributed to environmental contamination by toxic and hazardous wastes include:

1. Storage of explosives in the magazine area by several subsequent operations from 1948 to the present;
2. Operation of vehicle maintenance/motor pool facilities by the West Virginia National Guard from 1958 to the present;
3. Furniture manufacture by Mason Furniture Co. from 1948 to the mid-1970s;
4. The recent storage of electrical equipment, including transformers, in the magazine area by Appalachian Power Co.; and
5. Operation of a municipal landfill by the city of Point Pleasant.

None of these subsequent operations used the industrial wastewater transport systems. Any solid or liquid industrial discharges from these subsequent operations are generally distinguishable from contaminants resulting from WVOW operations. The potential for significant contamination or contaminant migration from these sources is slight.

Based on the hydrogeologic setting of WVOW, the potential exists for contamination at WVOW to migrate via surface water and/or ground water pathways to the deeper layers of the aquifer or to the Ohio River. Contaminant migration is possible toward the city of Point Pleasant and Camp Conley community potable water supplies.

Contaminants most likely to migrate beyond the former installation boundaries and/or to present the most serious threat of environmental degradation and threat to human health are nitroaromatic residues [2,4,6-TNT, 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), and other TNT manufacturing byproducts, or environmental transformation products of TNT] remaining as a result of WVOW explosives production.

Many of these compounds are toxic and/or suspected human carcinogens and are persistent in the environment. Localized contamination of the shallow ground water and discharge to surface waters have been documented in the vicinity of the TNT Manufacturing Area. Dinitrotoluene (DNT) residues have been found in the soils of the TNT manufacturing area, the burning ground, the sediments of the surface waters receiving contamination, and the former wastewater storage lagoons.

For the purpose of clarification, when general reference is made to the explosive, such as in Fig. 2 which describes the TNT Manufacturing Area, the explosive is referred to as TNT, the common acronym. In this document, specific references to the chemical compound which is actually 2,4,6-trinitrotoluene, and its environmental concentration, use the acronym 2,4,6-TNT. References to concentrations of unspecified chemical mixtures of byproducts of 2,4,6-TNT manufacture and environmental transformation products of this compound are termed nitroaromatic compounds.

SURFACE HYDROLOGY

During the period of operation in the 1940s, WVOW was drained by two major streams, their tributaries, and a number of intermittent streams (see Fig. 3). The northern half of the installation, including the magazine area and the acid area, were drained by Mill Creek and a small, unnamed tributary. Mill Creek is a tributary to the Ohio River and enters the river along the western boundary of the installation. The Ohio River is located adjacent to the installation, along the western boundary near the administration area and along the north and south well fields. As shown in Fig. 3, the southern and eastern sections of the installation were drained by Oldtown Creek. This stream and a number of smaller tributaries drained the TNT Manufacturing Area. Oldtown Creek is also a tributary to the Ohio River and intersects the river

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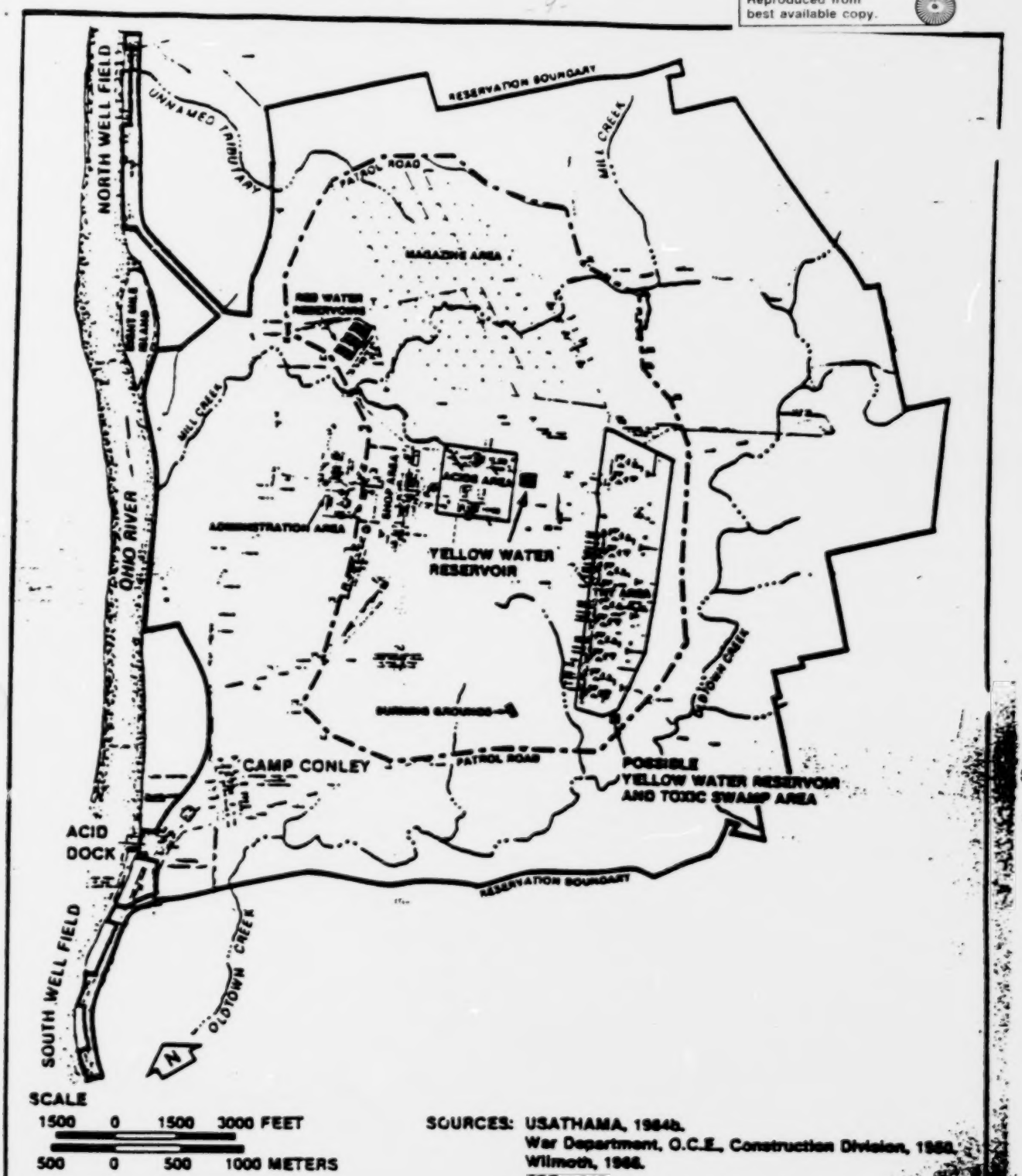

Figure 3, Page 9
SURFACE HYDROLOGY AT WVOW (1942)

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south of the installation. Three surface impoundments called the Red Water Reservoirs were located in the northwest section of the installation. These reservoirs had a total capacity of 30 million gallons (MG). A small reservoir called the Yellow Water Reservoir was located adjacent to the Acids Area. This reservoir had a capacity of 5 MG. A smaller water recovery reservoir, was located in the TNT production area; the capacity of this reservoir is unknown. During plant operations, a wetlands southeast of the TNT Manufacturing Area reportedly received runoff and process water from TNT lines 1-4. This lowlands, reportedly located at the present date site of McClintic Pond 10, was referred to as the the "Old Yellow Water Reservoir" and the "Toxic Swamp". It should be noted that the exact location and operational history (if any) of the old Yellow Water Reservoir and Toxic Swamp are not known.

A number of manmade surface water features were constructed subsequent to installation closure in 1945. Thirty-nine ponds are currently located at the McClintic Wildlife Station (see Fig. 4). Most of these ponds were constructed between 1953 and 1975 by the construction of impoundments and water control structures (e.g., dams and weirs) along the various drainageways. The ponds were constructed to provide wetland habitats for various wildlife species. Currently, two of the three Red Water Reservoirs contain standing water; the northernmost reservoir is empty and has revegetated. The Yellow Water Reservoir that was present in 1945 was filled shortly after the installation closed in the mid-1940s and the small water recovery reservoir located in the TNT Manufacturing Area was removed prior to 1975. Natural drainage by Mill Creek and Oldtown Creek has remained similar to the 1940s drainage, except for alteration of a number of tributaries due to pond construction.

SITE GEOLOGY

WVOW is located in the Ohio River basin, which consists of Pennsylvanian-age rocks overlain by Quaternary alluvium. The rocks underlying the installation are part of the Parkersburg syncline. The synclinal axis is located approximately 20 miles southeast of WVOW and has a northeast-southwest orientation. The oldest exposed rocks are Pennsylvanian in age and crop out along stream valleys. Fig. 5 shows a generalized geologic cross section across WVOW developed by Wilmoth (1966). Crystalline basement occurs between 9,000 ft and 11,000 ft below the Mississippian age rocks.

The Mississippian System includes the Pocono and MacCrady Formations overlain by the Greenbrier and Mauch Chunk Groups. The Pocono Formation consists of mostly coarse-grained sandstone and sandy shale, with a

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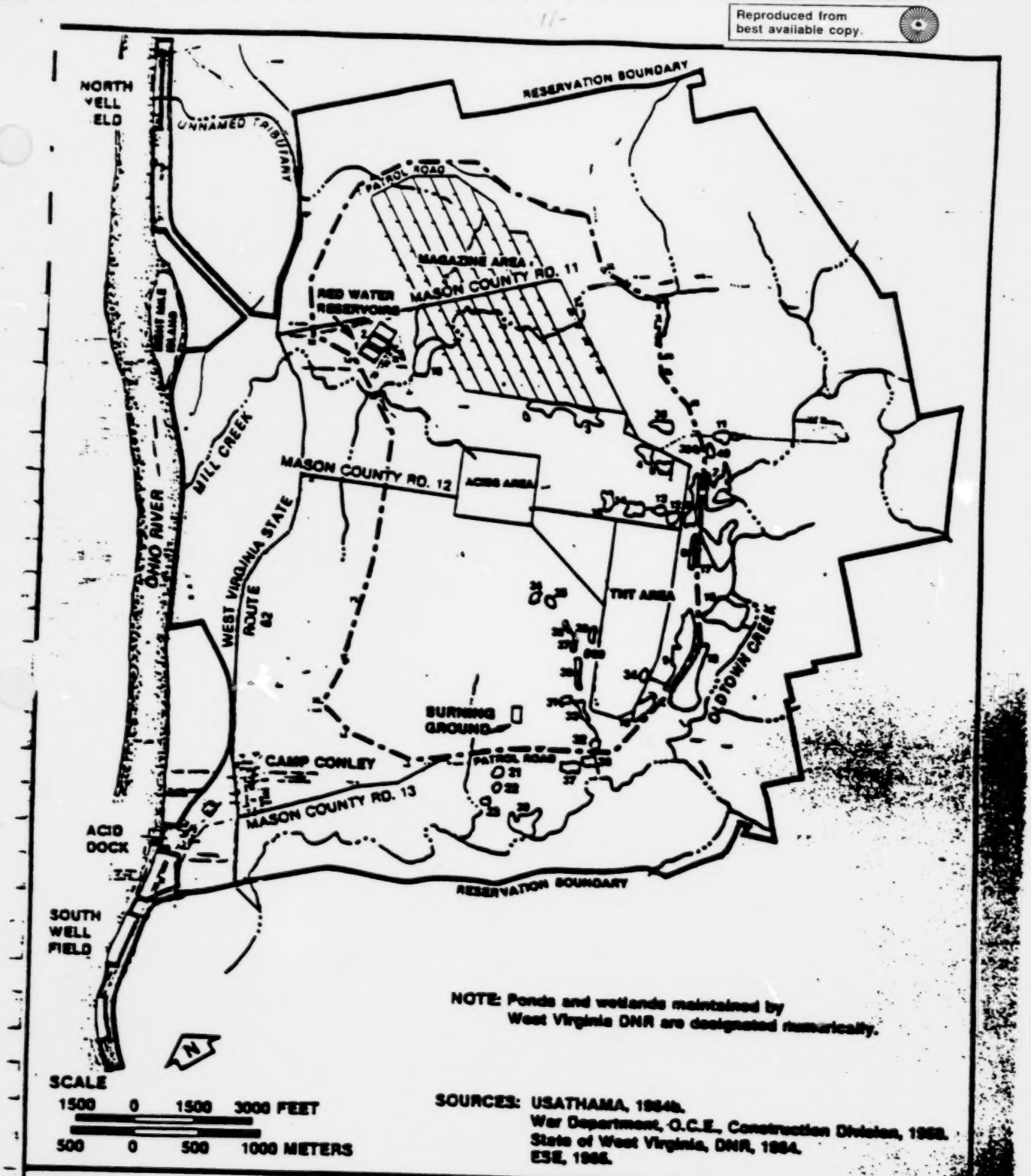

NOTE: Ponds and wetlands maintained by West Virginia DNR are designated numerically.

SOURCES: USATHAMA, 1984b.
War Department, O.C.E., Construction Division, 1958.
State of West Virginia, DNR, 1984.
ESE, 1985.

Figure 4, Page 11
URFACE HYDROLOGY AT THE
WVOW SITE (1985)

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thickness of between 480 and 580 ft. The MacCrady Formation is a shale unit, with an approximate thickness of 50 ft. The Greenbrier Group primarily consists of limestone, with some thin units of shale and sandstone. This group has a thickness of between 100 and 215 ft; wells screened in this unit produce a nonpotable saline brine. The Mauch Chunk Group consists of sandstone and shale units, with a thickness of up to 80 ft. Wells in this unit also produce a saline brine, with a yield of around 1 gallon per minute (gpm). The Pennsylvanian System includes the Pottsville, Allegheny, Conemaugh, and Monongahela Groups. These units have a combined thickness of between 260 and 955 ft and were deposited in a freshwater environment; all the groups contain carbonaceous deposits. The Pottsville Group is the basal unit of the Pennsylvanian System. The unit consists of coarse-grained sandstone, with thin beds of coal, shale, and clay. Figure 6 shows the major geologic units that comprise the Allegheny. The formation is between 185 and 250 ft thick in the vicinity of WVOW. The Allegheny does not crop out in Mason County and is encountered only in subsurface borings. The Conemaugh Group overlies the Allegheny Group and has a thickness of between 480 and 600 ft. The group consists of alternating sandstones, shales, and limestones, with some coal and clay units. The youngest Pennsylvanian unit is the Monongahela Group; this group also contains alternating shales, sandstones, and coal. The cross section (see Figure 5) from Wilmoth's (1966) ground water study shows the bedrock to be part of the Conemaugh Group; however, the geologic map from the same study indicates that rocks of the Monongahela Group underly the area. Rocks from both of these groups are primarily clastic with minor amounts of limestone and coal. The Conemaugh Group contains a larger percentage of sandstone than the Monongahela Group, and both groups contain siltstones and shales. Thickness ranges from 230 to 320 ft; these units form the upland areas on the east side of WVOW.

Overlying the Paleozoic rocks at WVOW is an alluvial unit that reaches thicknesses of up to 185 ft (see Figure 6). The alluvium is found as river floodplain deposits and elevated terraces along the Ohio River. The terraces along the Ohio River were deposited as glacial outwash to the south of the Wisconsin continental ice sheet. The alluvial deposits overlying bedrock to the east and northeast of WVOW were deposited in the channel of a pre-glacial river that flowed southward from Ohio through northern Mason County and then westward back into Ohio. The alluvium consists of a basal gravel-sand unit and increases in coarseness from top to bottom, with a clay and silt floodplain near land surface. Figure 7, taken from Wilmoth (1966), shows a generalized cross section of these upper geologic units.

The 1966 Wilmoth study was produced from a limited database in the immediate vicinity of WVOW and was oriented primarily to defining and delineating potable ground water supplies in Mason County. The major

aquifer of concern, therefore, was the productive glacial outwash sediments immediately overlying the bedrock. The shallow alluvial aquifer at WVOW would not have been considered an important potable water supply aquifer and may not have been detected or adequately defined in the 1966 study. The water table shown in Fig. 7 represents the interpreted potentiometric surface of the glacial outwash aquifer, which was assumed to be in hydraulic communication with the Ohio River.

During the phases of deposition, the Ohio River Valley probably was filled with at least 135 ft of sediment; complete sections of these deposits are preserved within the WVOW area. As the river valley filled with coarse sediment, water probably became ponded and allowed finer sand, silt, and clay to be deposited.

The log of a USGS test boring (Table 2) made in 1960 and located just east of the TNT Manufacturing Area shows this fining, upward, depositional trend. This boring contains 103 ft of interbedded sands and gravels which are overlain by 12 ft of fine sand, silt, and clay.

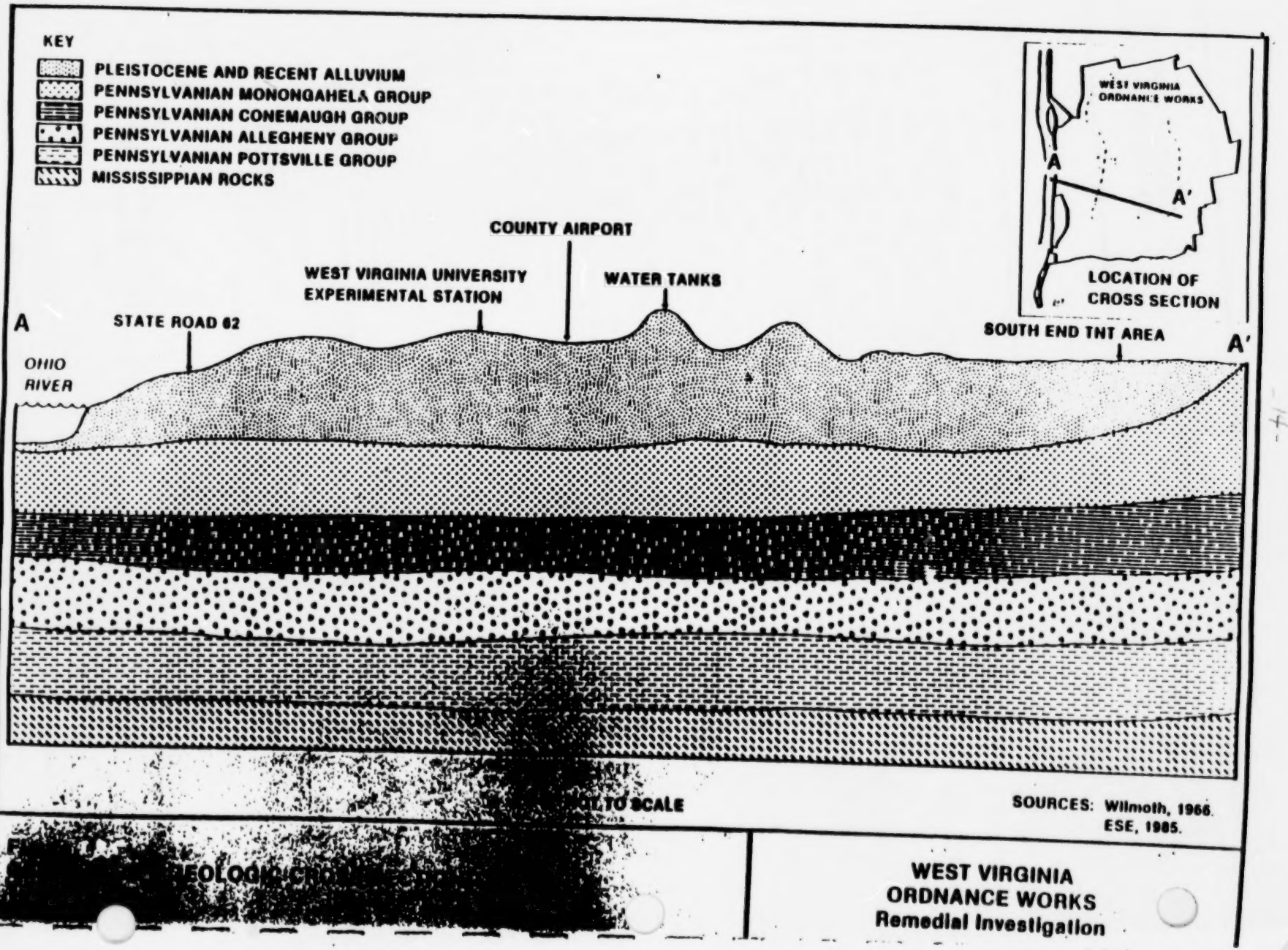
SITE SOILS

The U.S. Soil Conservation Service (USSCS) (1961) has mapped and identified the soils on WVOW. Two regional soil associations are present on the installation along the Ohio River bottomlands and terraces; the Aston, Wheeling, and Lakin Associations are predominant. The upland areas can be grouped into the Muskingum, Upshur, and Vandalia Associations. The bottomlands and river terrace deposits consist of alluvial soil, with a thin veneer of recent river silt and clays. The upland soils consist of material weathered from the underlying bedrock, mostly sandstone, shales, and siltstone. A third major soil type consists of mixed amounts of alluvium and sediment disintegrated from the underlying bedrock. These mixed soils are located on upland terraces and consist of the Wheeling soil type on well-drained areas and the Sciotoville, Ginat, and Chilo soil types on the poorly drained areas.

Detailed soil locations, drainage characteristics, and permeabilities were determined by USSCS (1961) and are presented in Fig. 8 and Table 3.

SITE GROUND WATER

Ground water occurrences in the WVOW region have been documented by the West Virginia Geological and Economic Survey and USGS. Potable ground water in the vicinity of WVOW occurs in two main aquifer systems: an unconsolidated or alluvial aquifer system and the consolidated Pennsylvanian Aquifer System.


KEY
PLEISTOCENE AND RECENT ALLUVIUM
PENNSYLVANIAN MONONGAHELA GROUP
PENNSYLVANIAN CONEMAUGH GROUP
PENNSYLVANIAN ALLEGHENY GROUP
PENNSYLVANIAN POTTSVILLE GROUP
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WEST VIRGINIA UNIVERSITY EXPERIMENTAL STATION
WATER TANKS
STATE ROAD 62
SOUTH END TNT AREA
OHIO RIVER
TO SCALE
SOURCES: Wilmoth, 1966.
ESE, 1985.
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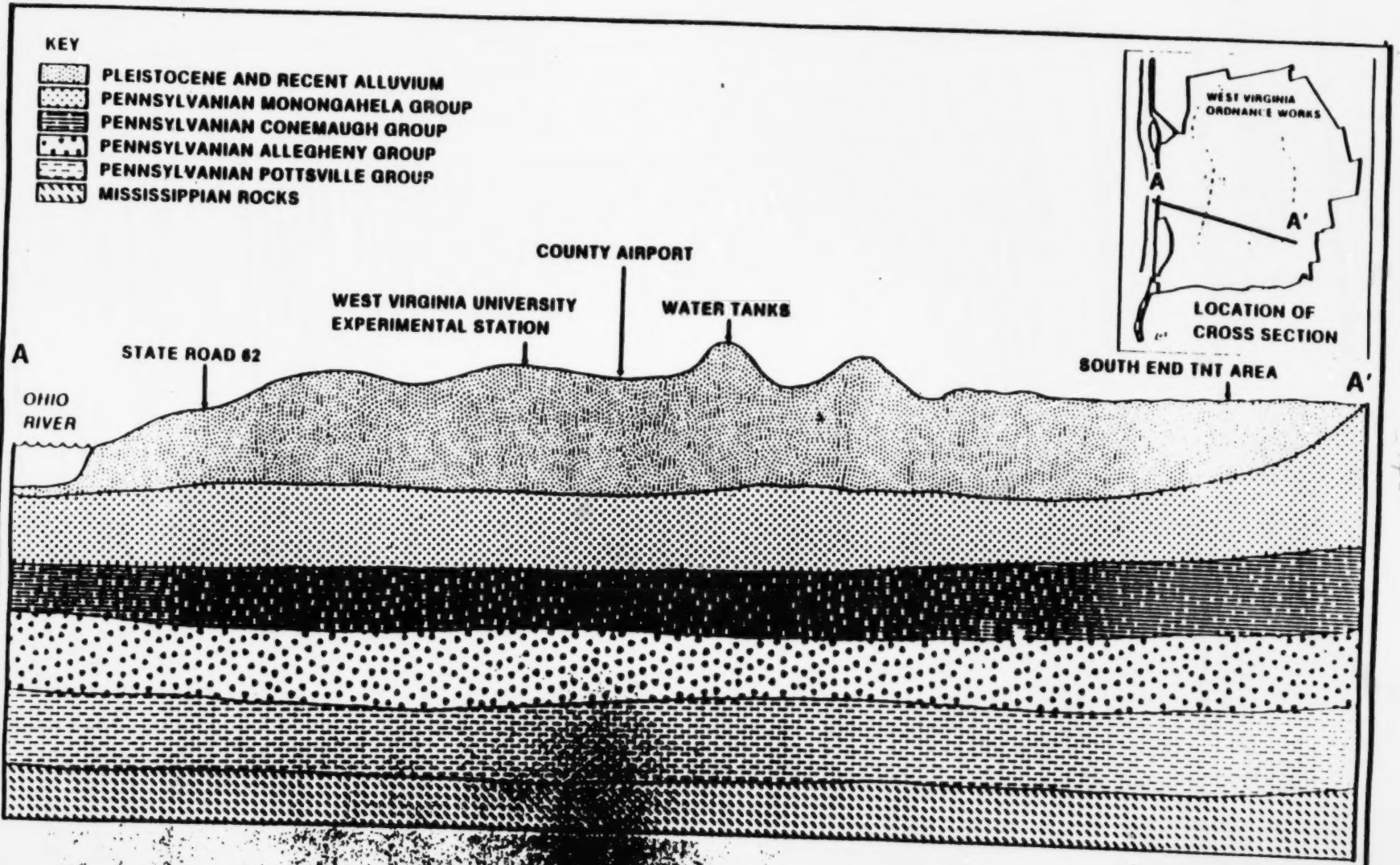
KEY
PLEISTOCENE AND RECENT ALLUVIUM
PENNSYLVANIAN MONONGAHELA GROUP
PENNSYLVANIAN CONEMAUGH GROUP
PENNSYLVANIAN ALLEGHENY GROUP
PENNSYLVANIAN POTTSVILLE GROUP
MISSISSIPPIAN ROCKS
WEST VIRGINIA ORDNANCE WORKS
A
A'
LOCATION OF CROSS SECTION
COUNTY AIRPORT
WEST VIRGINIA UNIVERSITY EXPERIMENTAL STATION
WATER TANKS
STATE ROAD 62
SOUTH END TNT AREA
OHIO RIVER
TO SCALE
SOURCES: Wilmoth, 1966.
ESE, 1985.
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ERA	PERIOD	SYSTEM	GROUP	GEOLOGIC UNIT	APPROXIMATE THICKNESS (ft)	WATER-BEARING CHARACTERISTICS
CENOZOIC	QUATERNARY	PLEISTOCENE		Alluvium, clay, silt, sand, gravel	1 to 135	Unconfined and semiconfined ground water; principal aquifer in Ohio Valley; average well yield 200 to 300 gpm; water quality good
PALEOZOIC	PENNSYLVANIAN	PENNSYLVANIAN	CONEMAUGH	Monongahela shale, coal Gilboy sandstone, shale Uniontown sandstone, shale Redstone coal Upper Pittsburgh sandstone, shale Pittsburgh coal	230 to 320	Some porous members act as aquifers; low well yield of about 10 gpm; water quality generally good, variable
			MONONGAHELA	Lower Pittsburgh sandstone Pittsburgh limestone Little Pittsburgh coal, clay Connellsville sandstone Clarksburgh shale, sandstone Waynesburg sandstone, shale Elk Lick shale, limestone Grafton sandstone Birmingham shale Upper Ames limestone Lower Ames limestone Saltsburg sandstone, shale Pine Creek shale Buffalo sandstone, shale Brush Creek coal Washington sandstone	480 to 605	Porous members serve as aquifer; low well yield of about 10 gpm; water quality variable; saline water in lower units
			ALLEGHENY	Upper Freeport coal Lower Freeport shale, coal Upper Kittanning shale Upper East Lynn sandstone Middle Kittanning clay East Lynn sandstone Lower Kittanning coal	185 to 255	Unit yields saline water for industrial uses; low well yield of between 1 to 50 gpm
			PottsVILLE	Homewood sandstone Stockton-Lewiston shale, coal Coalburg coal, clay Winfield coal Cedar Grove shale Sandstone (unnamed) Shale (unnamed)	350 to 955	Unit yields saline brine for industrial uses; well capacity about 7 to 50 gpm
	MISSISSIPPIAN	MISSISSIPPIAN		MAUCH CHUNK GROUP, shale	0 to 80	Yields saline brine
				GREENBRIER GROUP, limestone	100 to 125	Yields saline brine
				HACCOUDY FORMATION, shale	0 to 50	No yield
				POCONO FORMATION, sandstone	240 to 585	Yields saline brine
	DEVONIAN			PRE-MISSISSIPPIAN ROCK		

ft = feet.
gpm = gallons per minute.

SOURCES: Wilmoth, 1966.
ESE, 1985.

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PHY OF CONSOLIDATED AND
DATED DEPOSITS AT THE

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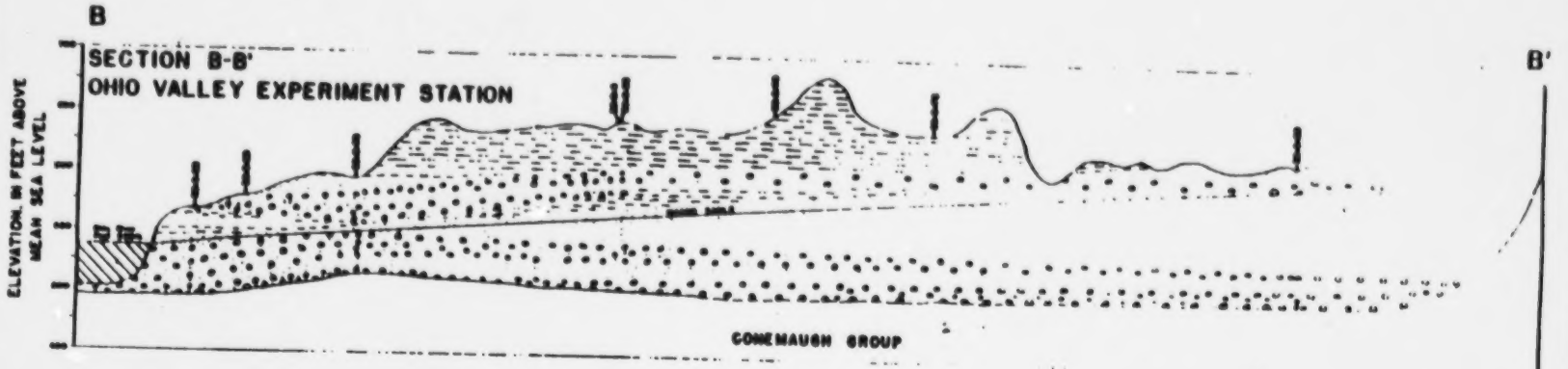

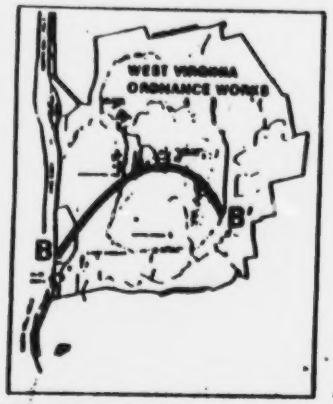

LOCATION OF CROSS SECTION

KEY
- CLAY AND SILT
- SAND
- SAND AND GRAVEL

SCALE

600 0 600 1,200 FEET

200 0 200 400 METERS

SOURCES: Wilmoth, 1966
ESE, 1985.

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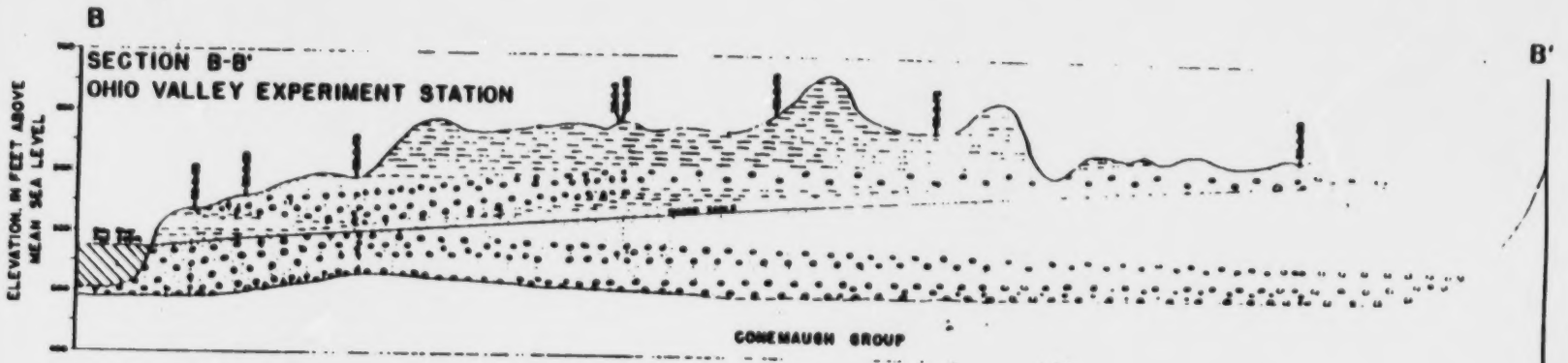

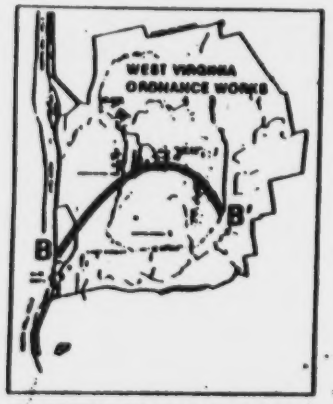

LOCATION OF CROSS SECTION

KEY
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- SAND AND GRAVEL

SCALE
600 0 600 1,200 FEET
200 0 200 400 METERS

SOURCES: Wilmoth, 1966
ESE, 1985.

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Table 2 Log of USGS Test Boring Located East of TNT Manufacturing Area

Test boring 38-3-88
Altitude of Land Surface: 610 ft. MSL
Sample log by B.M. Wilmoth

Quaternary System	Thickness (ft)	Depth (ft)	Remarks
Clay, silty, medium-brown	4	4	
Sand, very fine-grained, and silt, trace of clay, medium-brown	6	10	
Sand, fine-grained, trace of silt, and clay, medium-brown	2	12	
Sand, medium-grained, trace of fine-grained, and trace of gravel, fine, medium-brown	7	19	
Sand, medium- and coarse-grained, medium-brown, wet	4	23	Static water level, 19 ft
Sand, coarse-grained, medium-brown, fluid	4	27	
Sand, coarse-grained, medium-brown, very fluid	30	57	
Sand, coarse-grained, trace of fine-grained and coarse-grained, medium-brown	30	87	
Gravel, fine to medium	3	90	
Sand, medium-grained, medium-grayish-brown	2	92	
Clay, bluish gray, plastic	1	93	
Gravel, fine to coarse, and sand, coarse-grained, medium-grayish brown, and some thin layers of clay, dark gray, plastic, stratified	7	115	Bedrock at 115 ft

Figure 8 , Page 18
SOILS MAP OF THE
WVOW SITE

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Table 3 Soil Types Within the WVOW Site

Soil Type	Soil Description	Drainage	Permeability
As	Ashton Silt Loam	Well Drained	Moderate-Rapid
ChA	Chilo Sandy Loam	Poorly Drained	Slow
Du	Duncannon Silt Loam	Well Drained	Moderate
GsA	Ginat Silt Loam	Poorly Drained	Very Slow
Ha	Hackers Silt Loam	Well Drained	Moderate
Hu	Huntington Silt Loam	Well Drained	Moderate
La	Lakin Loamy Fine Sand	Excessively Drained	Rapid
Ma	Markland Silty Clay Loam	Moderately Poorly Drained	Slow-Very Slow
Me	Melvin Silty Clay Loam	Poorly Drained	Moderate Slow-Very Slow
Mg	Monongahela Silt Loam	Moderately Well Drained	Slow
Mo	Moshannon Silt Loam	Well Drained	Moderate
Mu	Muskingum-Upshur Silt Loam	-	Moderate
Sc	Sciotoville Silt Loam	Moderately Well Drained	Moderate-Slow
Se	Senecaville Silt Loam	Moderately Well Drained	Moderate-Slow
So	Sloping Land	-	-
Uc	Upshur Clay Loam	Well Drained	Slow-Very Slow
Um	Upshur-Muskingum Clay Loams	-	-
Va	Vandalia Clay Loam	Well Drained	Moderate-Slow
Wn	Wheeling Fine Sand Loam	Well Drained	Moderate-Rapid

The gravel and sand lenses in the glacial alluvium constitute the principal aquifer at WVOW. These deposits are the most productive ground water units, with a high hydraulic conductivity and fairly high well yields. The water table in Mason County was reported to range from about 10 to 90 ft below land surface. At the WVOW site, the level at which ground water may be encountered was expected to range from 5 to 45 ft below land surface. Recharge to the alluvial aquifer consists of infiltration of precipitation, movement of ground water from the bedrock to the alluvium, seepage from small streams flowing across the terrace deposits, and recharge from the Ohio River during periods of high stage or flooding. Industrial and public-supply wells in the area have an average yield of 200 gpm according to Wilmoth (1966). WVOW radial collectors located adjacent to the Ohio River ranged from 1,245 to 1,918 gpm, with a 1,565-gpm average. Aquifer tests on a number of municipal well fields in the alluvium indicated moderately good transmissivity and water-table storage.

Based on historical well construction information and water-level data available prior to the RI, a ground water divide appeared to exist, most likely in the area of the TNT production lines. Because of the lack of well location and water-level data for the northeastern portion of WVOW, the exact location of the probable divide could not be determined. Ground water movement in the alluvial aquifer appeared to move to the northwest from the TNT Manufacturing Area to the Mill Creek drainage and to the southwest along the Oldtown Creek drainage after moving eastward to Oldtown Creek. Ground water recharging the alluvial aquifer in the relatively high elevations along the eastern edge of WVOW probably moves directly west to the Ohio River via Oldtown Creek. Recharged ground water in the high elevations west of the TNT Manufacturing Area may move directly west to the Ohio River.

As a result of the apparent complexity of local ground water movement patterns in the upper portion of the alluvial aquifer, piezometers were installed in the earliest phase of the RI program to determine local gradients and aid in proper placement of the contaminant monitoring wells.

The Monongahela and Conemaugh Groups form the deep potable Pennsylvania aquifer system underlying WVOW. The Monongahela Group yields enough water for domestic supply from a number of porous sandstone units. Well yields range from 1 to 25 gpm, with an average of 9 gpm. The Monongahela contains less sandstone than the Conemaugh and is situated topographically higher. These factors make the Conemaugh aquifer the better water-bearing formation. The Conemaugh is the principal aquifer to the south of WVOW in the Kanawha River Valley. Most wells that draw from this aquifer are for domestic and farm supplies, although a few industrial and public supplies tap this formation. Well yields for this aquifer range from less than 1 to 102 gpm and average about 9 gpm. Transmissivity and storage coefficients calculated from aquifer tests show a wide range of values, depending on the zone of production and lithology encountered. The lower units of the aquifer yield saline water in some sections and are not suitable for domestic or public usage. Aquifer tests in the Pennsylvanian rocks, where overlain by alluvium, commonly show some indication of hydraulic connections between the bedrock and the alluvium and/or the river. Water levels recorded in the alluvial and Pennsylvanian aquifers have shown variable head differences between the the potentiometric surfaces of the two aquifers. Vertical gradients developed in the vicinity of WVOW show head differences as great as 30 ft. Much of the ground water encountered in the deeper aquifer system is presumed to occur in joint-openings, along bedding planes, and in the rock's pore space.

A series of nonpotable aquifers are present at depths below WVOW. These aquifers consist of Pennsylvanian and Mississippian age rocks that yield saline brines. These brines have a number of industrial uses such as cooling fluid and for the production of chlorine, bromine, and other elements. Although generally these brines lie below the potable upper aquifer systems, at least three brine wells less than 200 ft deep occur in the vicinity of WVOW and were as identified during the RI. During the 1800s several operations existed along the reach of the Ohio River near Point Pleasant to make salt by evaporation of brine from well water.

Two natural springs are located adjacent to WVOW. A small spring was present prior to 1966 about 1,500 ft south of the installation along State Rt. 62. This spring had about a 0.1-gpm flow rate and was used for domestic supply at times. The source of the spring was the Conemaugh aquifer. The second spring was located approximately 500 ft east of the installation boundary along Potter Creek. This spring flowed from the Monongahela aquifer and had a yield of around 0.1 gpm. This spring was used for stock watering and was not a potable water supply.

SUMMARY AND CONCLUSIONS OF RI FOR FIRST OPERABLE UNIT

In January 1986, in a mutual agreement between EPA and DOD, it was decided that in order to expedite the implementation of remedial actions that subsequent studies at the site would be divided into two operable units and that remedial efforts for the first operable unit would be initiated while additional data is gathered for the areas in the second operable unit.

This section summarizes the principal findings of the first operable unit RI and is organized according to the areas of concern which are 1) the TNT Manufacturing Area including surface and underground wastewater transport lines, and 2) the Burning Grounds. Contaminant sources are identified and observed levels of contamination in the various media (i.e., ground water, surface water, sediments) are indicated. Actual migration or the potential for migration of the observed contaminants are discussed, and exposure pathways and potential receptors are identified.

TNT MANUFACTURING AREA

1. Contaminant sources observed in the TNT Manufacturing Area include residual nitroaromatic compounds and the soils that had come into contact with these compounds. Crystalline residues containing up to 70-percent nitroaromatics were observed in one of the excavated sewerlines, and soils beneath most of the sewerlines that were excavated contained visible discoloration and had detectable levels (10 to 500 ug/g) of nitroaromatic contamination. Additional contaminant soures exist due to nitroaromatic residues (up to 20,000 ug/g) in surface soils within 5 to 10 m (i.e., 16 to 32 ft) of the foundations of the process (i.e., nitrating) and refining (i.e., washer/flaker) facilities. The principal nitroaromatic contaminant in soils is 2,4,6-TNT. 2,4-DNT and 1,3-DNB were also detected.

2. Nitroaromatic contamination was observed in ground water in the shallow, water-table aquifer, in the shallow ground water emanating from seeps, and in the surface water in Pond 34. Highest levels of nitroaromatic contamination (up to 14,000 ug/L) were observed in the shallow ground water in the vicinity of the Red/Yellow Wastewater Sewerlines in the main TNT processing area. This contamination apparently resulted from leakage of red/yellow wastewater along the underground sewer or infiltration from contaminated soils adjacent to the processing facilities. Lower levels (up to 100 ug/L) of nitroaromatic contamination were observed in the shallow ground water along the TNT Manufacturing Area east perimeter road, downgradient of the primary processing facilities and sewerlines. This contamination may result from the migration of contaminants that were observed in the ground water along the Red/Yellow Water Sewerlines in the main processing area or from spillage of finished TNT in the areas near the conveyors and/or nail houses.

3. The only surface water feature in the TNT Manufacturing Area, Pond 34, contained low but detectable levels of 2,4-DNT (0.8 ug/L) and 2,4,6-TNT (0.4 ug/L). These levels are below the 10^{-5} human health criteria for 2,4-DNT (1.1 ug/L) and 2,4,6-TNT (44 ug/L). This contamination apparently results from surface runoff of water from contaminated soils in the TNT Manufacturing Area and/or seepage of ground water through the sediments of the pond. No surface seeps were identified leading into this pond during the RI.

4. Ground water migration of nitroaromatics is occurring from the TNT Manufacturing Area through the shallow, water-table aquifer to ground water seeps downgradient of the southeast end of the TNT Manufacturing Area. While nitroaromatic contaminants (up to 200 ug/L) have been measured in the ground water seeps which then migrate to Ponds 9 and 10, nitroaromatic contamination was not detected in either the surface water or sediments of these ponds.

5. Surface migration of contaminants from the TNT Manufacturing Area is occurring via drainage of water containing nitroaromatics from Pond 34, through a culvert beneath the east perimeter road and into Pond 9. Detectable levels of nitroaromatics, however, were not observed in the water or the sediments of Pond 9.

6. The ground water gradient in the TNT Manufacturing Area is toward the east-southeast with an estimated velocity of 0.6 ft/day. No westerly component was observed. A lateral flow component occurs toward the east-southeast in the shallow, water-table aquifer due to infiltration of rainfall and the low permeability of the underlying gray clay confining unit. This lateral flow results in the observed downgradient ground water seeps. The potential for downward migration of contaminants into the deep, confined alluvial aquifer is precluded due to the confining gray clay unit.

7. No migration of contaminants to Oldtown Creek was observed in either the ground water or surface water. The areally limited, silty sand lens penetrated by monitor well GW21 contained a low level of 2,4,6-TNT (0.8 ug/L) and low levels of trace metals, which may indicate residual contamination from overflow of the old Yellow Water Reservoir/toxic swamp area.

8. Exposure pathways to humans and animals for the nitroaromatic contaminants observed in the TNT Manufacturing Area include both direct and indirect routes. Direct exposure of animals and humans to nitroaromatic contamination can occur via direct contact (dermal and/or inhalation) with nitroaromatic residues in the soils adjacent to the processing and refining facilities or via direct contact with the contaminated ground water seeps. Indirect exposure can occur via terrestrial and aquatic food chain mechanisms. In addition to the chemical hazard associated with exposure to nitroaromatics, a physical hazard exists due to the numerous open manholes in this area, most of which are concealed by vegetation.

BURNING GROUNDS

1. Nitroaromatic contamination, including pieces of crystalline TNT and soils containing up to 4-percent (40,000 ug/g) nitroaromatics exists in the soils of both the East and West Burning Grounds area. In addition to the nitroaromatic contamination, the soils of the West Burning Grounds contain Polynuclear Aromatic Hydrocarbons (PAHs), including benzo(a)pyrene, large piles of friable asbestos, deposits of elemental sulfur, and lead concentrations of up to 1,400 ug/g. These contaminants principally are confined to the surface soil layer only.

2. No contamination by nitroaromatic compounds or priority pollutant organics was observed in the ground water in the Burning Grounds area. Additionally, no nitroaromatic contamination was detected in the surface waters downgradient of the Burning Grounds. One sediment sample at OTC4, downgradient of the Burning Grounds area, however, did contain a low (0.2 ug/g) but detectable level of 1,3-DNB. Asbestos contamination (2.6×10^6 fibers/L) was observed in the surface waters downgradient of the Burning Grounds.

3. The only evidence of nitroaromatic contaminant migration via surface water runoff from the Burning Grounds area was the low level of 1,3-DNB that was detected in the sediment at OTC4. Asbestos migration is occurring from this area via surface erosion into downgradient surface waters.

4. Immediately below both the East and West Burning Grounds is 30 to 35 ft of clay deposits. The observed ground water gradient is toward a trough beneath the East Burning Grounds and toward the west in the area of the West Burning Grounds. The surface clay deposits, however, in the vicinity of Monitor Wells GW3 and GW4 are thin and have been eroded. Elevated levels of sulfate and dissolved solids in the ground water at these locations indicate a potential migration pathway exists for surface water infiltration to the water-table aquifer in this area, which is topographically downgradient of the West Burning Grounds. No contamination by nitroaromatics, however, was detected in the ground water.

5. During the dry period of summer and early fall, an atmospheric route for migration of nitroaromatics, asbestos, PAHs, and lead also exists from the Burning Grounds area via wind-induced suspension of soil particulate material. No measurements were performed during the RI to quantify this atmospheric migration rate. However, due to climatological conditions for this area, the atmospheric rate is likely small compared to the surface runoff/erosion rate.

6. Direct and indirect exposure pathways to humans and animals exist for the contaminants observed in the Burning Grounds area. Direct exposure of humans and animals to the observed soil contaminants (nitroaromatics, asbestos, PAHs, and lead) can occur via contact (dermal) with the soils in the Burning Grounds. Direct contact can also occur via inhalation of suspended soil particulates containing these contaminants. Indirect exposure exists via both aquatic and terrestrial food chain mechanisms.

INVESTIGATIONS BEYOND McCLINTIC

1. Thirteen domestic/municipal water supply wells were sampled during the RI. All but one well (the McClintic Doghouse Well) are located off the McClintic State Wildlife Station. Each of the wells, however, is located within the former boundary of WVOW as it existed during WWII. No nitroaromatic compounds or significant trace metals were detected in the ground water from any of the water supply wells. All of the supply wells are installed in the deep, confined, alluvial aquifer due to the high yields from this zone. Nitroaromatic contamination from the TNT Manufacturing Area is limited to the shallow, water-table aquifer located in the sands above the confining clay units. Several monitoring wells installed during the RI through the confining gray clay unit exhibited artesian conditions, with Monitor Wells GW21D and GW22D having continuous flow from the well casing. The confining clay units and the observed artesian conditions of the deep, alluvial aquifer greatly limit the potential for contamination of this aquifer.

2. The sampling and analysis of water/sediment along Oldtown Creek and the principal tributaries draining the site indicate that significant asbestos migration is occurring from the Burning Grounds area.

3. The remelt facility is located in the southern portion of the magazine area along the upper reaches of Mill Creek. This operation has been in existence since the 1950s to melt and recast explosives reclaimed from ordnance materials. Sampling and analysis of soils adjacent to this facility indicate that nitroaromatic contamination exists in the soils at levels up to 6,000 ug/g. No nitroaromatic compounds were detected in either the surface water or sediment at sampling locations in the Mill Creek drainage system adjacent to the remelt facility. Apparently, erosion of the contaminated soils adjacent to the remelt facility and transport into Mill Creek is not occurring or the rate is insignificant compared to inputs of uncontaminated water and sediments.

CONTAMINATION STATUS

The following paragraphs are a summary of the overall site contaminant sources, contaminated media, hydrogeological setting, contaminant migrations and exposure pathways. See Figures 9 through 13 for the locations of ground water monitoring wells and soil, surface water and sediment sampling locations. The principal sitewide contaminants are nitroaromatic residues, and the predominant compound observed was 2,4,6-TNT although, 1,3,5-TNB and 2,4-DNT were also widely distributed. The major nitroaromatic contaminant source areas were:

1. The surface and subsurface soils in the TNT Manufacturing Area.
2. The industrial sewerlines in the TNT Manufacturing Area and the trunk sewerlines leading from the Pond 13 area to the outfalls and
3. The surface soils in the East and West Burning Grounds.

In the surface soils of the TNT Manufacturing Area and the Burning Grounds concentrations ranging to the low percent levels (<10 percent) were encountered. The industrial sewerlines exhibited concentrations reaching 71%. These source areas contribute surface water and ground water contamination by nitroaromatics and represent a hazard to human beings and wildlife as a result of direct contact.

Asbestos, disposed primarily at the West Burning Grounds, represents a direct contact hazard in this area. Surface water migration of asbestos is occurring into the drainage leading from this source area into Oldtown Creek. Waters of the drainage area and Oldtown Creek are not used as drinking water sources or for body contact recreation. PAHs and lead also were observed in the West Burning Grounds. Although these contaminants represent a potential contact hazard in the source area, no generalized migration appears to have occurred. Asbestos also exists offsite in the powerhouses and Mason Furniture Co. Access to the south powerhouse is not restricted. Both powerhouses and the Mason Furniture Co. are privately owned.

The major contaminated media are the following:

1. The source area soils described above and soils/sediments which have eroded from the contaminated sources;
2. The shallow aquifer underlying the TNT Manufacturing Area;
3. The surface water and sediments of Pond 13 which are being contaminated by nitroaromatic residues traveling down the gradient of the sewerline from the TNT Manufacturing Area and/or from the Wet Wells; and
4. Waters of Pond 34 on the east side of the TNT Manufacturing Area.

WVOW is located on alluvial terraces of the Ohio River and is drained primarily by two creek systems, Oldtown Creek and Mill Creek. Mill Creek drains the northern portion of the site including the Red Water Reservoirs, Yellow Water Reservoir, Acids Area, and the magazine area. Oldtown Creek drains the Pond 13 area, the TNT Manufacturing Area, and the Burning Grounds. A total of 39 impoundments has been developed on WVOW for the propagation of fish and waterfowl.

The sediments above bedrock consist of layers and beds of gravel, sand, silts, and clays which were deposited by the Ohio River as alluvium since the Pleistocene glaciation. The surface sediments consist mainly of silty clays in the southern portion of the site. The surface sediments in the northwestern section are silts and sands of varying clay content. A gray clay stratum exists at an elevation approximately 560 ft-MSL and lies up to 20 to 30 ft below the surface. This layer acts as a confining layer, dividing the aquifer system into two parts. Above the confining layer a shallow water-table aquifer exists in which ground water flow is primarily laterally to the east from the TNT Manufacturing Area.

In the Burning Grounds, the ground water movement in this aquifer is complex. The clay confining layer is thickest under the Burning Grounds and the TNT Manufacturing Area. Below the confining layer a second alluvial aquifer system exists which is under artesian pressure. At the center and southeastern portion of the site the potentiometric surface is higher that the land surface. Vertical gradients vary from upward in these areas to strongly downward in the center of the TNT Manufacturing Area. Contamination is confined to the shallow aquifer system and is migrating from the TNT Manufacturing Area. Contaminated ground water discharges from the shallow aquifer to Ponds 9 and 10 via a series of seeps at the base of the escarpment along the southern and southeastern edge of the TNT Manufacturing Area.

Migration of nitroaromatics is retarded significantly in the ground water compared to the migration of the associated releases of sulfate and nitrate. Contamination migration in surface waters (Pond 13 and Pond 34), and from the seeps into Ponds 9 and 10 is limited by dilution and by fate processes, primarily photolysis. No offsite surface water contaminant migration or significant onsite spread was observed.

Direct and indirect contact via the food chain through hunting and fishing are potential exposure pathways for nitroaromatic residues from the soils. The ground water exposure pathway from the shallow, contaminated aquifer in the TNT Manufacturing Area is via discharge to surface waters and taking of fish and/or waterfowl.

CONTAMINANT MONITORING WELLS

Fifty monitor wells were installed in two phases (Phase IA and Phase IB) during the WVOW investigation. During Phase IA, 26 shallow monitor wells and 3 deep monitor wells were installed; during Phase IB, 15 shallow monitor wells and 6 deep monitor wells were installed. The locations of monitor wells are shown in Figures 9, 10 and 11. The locations, depths, and screened intervals of monitor wells were selected to delineate contaminant distribution and the geohydrological environment. This selection was based on the results of ground water data obtained from the observation wells, subsurface conditions observed during drilling, and from preliminary results of the geophysical survey which was being conducted concurrently with the observation well installation. The Phase IA monitor wells were installed from October to December 1984, immediately after assessment of ground water level data from the observation wells.

Because of the time constraints of this study, Phase IB well installation proceeded immediately following the conclusion of Phase IA drilling. Location and screen intervals for Phase IB wells were based on the results obtained from the Phase IA sampling. Ground water samples collected during well development of Phase IA wells were analyzed using a rapid colorimetric TNT detector kit. This detector kit provided a rapid presence-absence determination for nitroaromatic compounds and was instrumental in the selection of several Phase IB wells.

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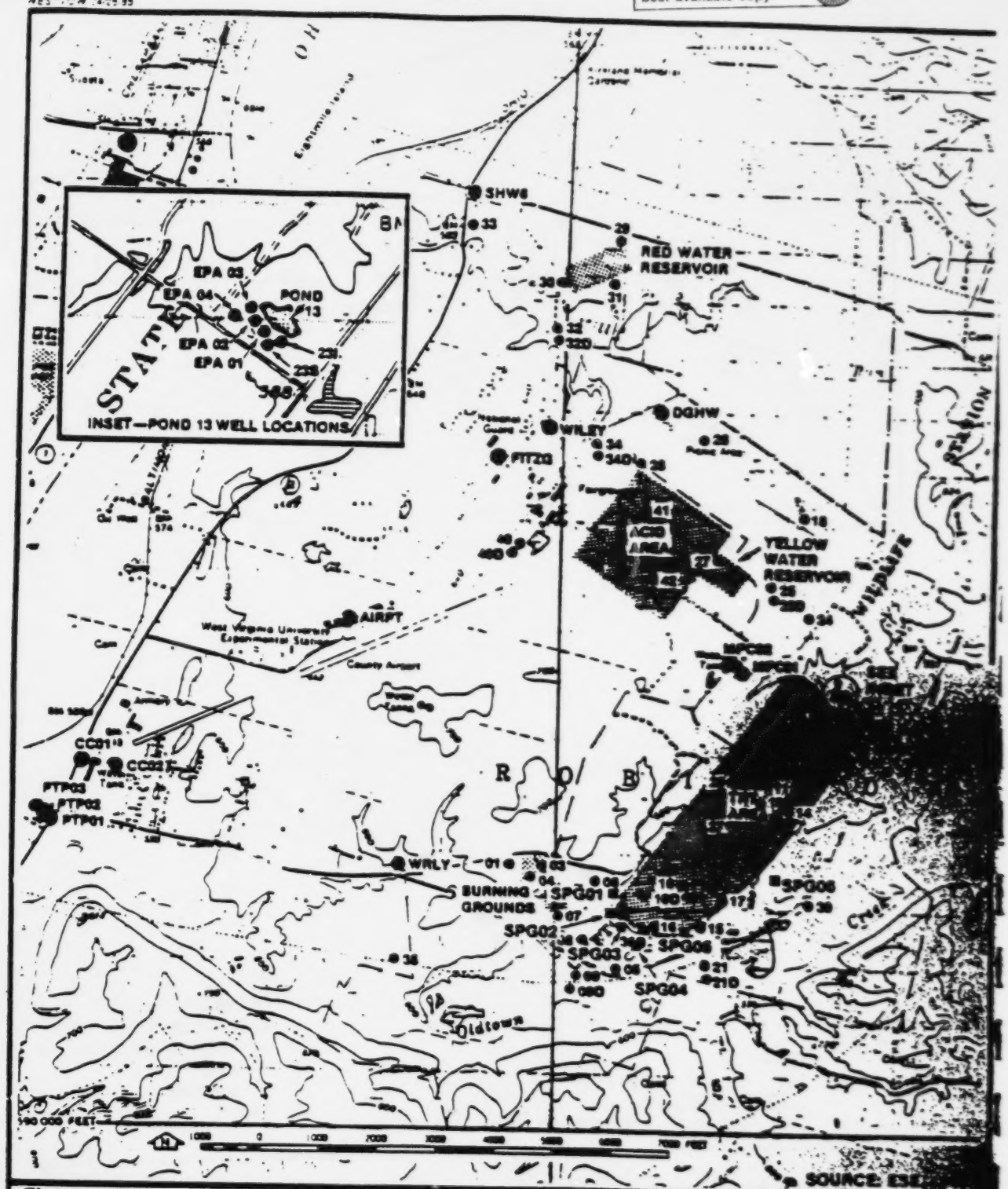

Figure 9 Page 29
LOCATIONS OF MONITOR WELLS, INCLUDING EXISTING EPA WELLS 01, 02, 03, AND 04 AND OFFSITE SAMPLING WELLS

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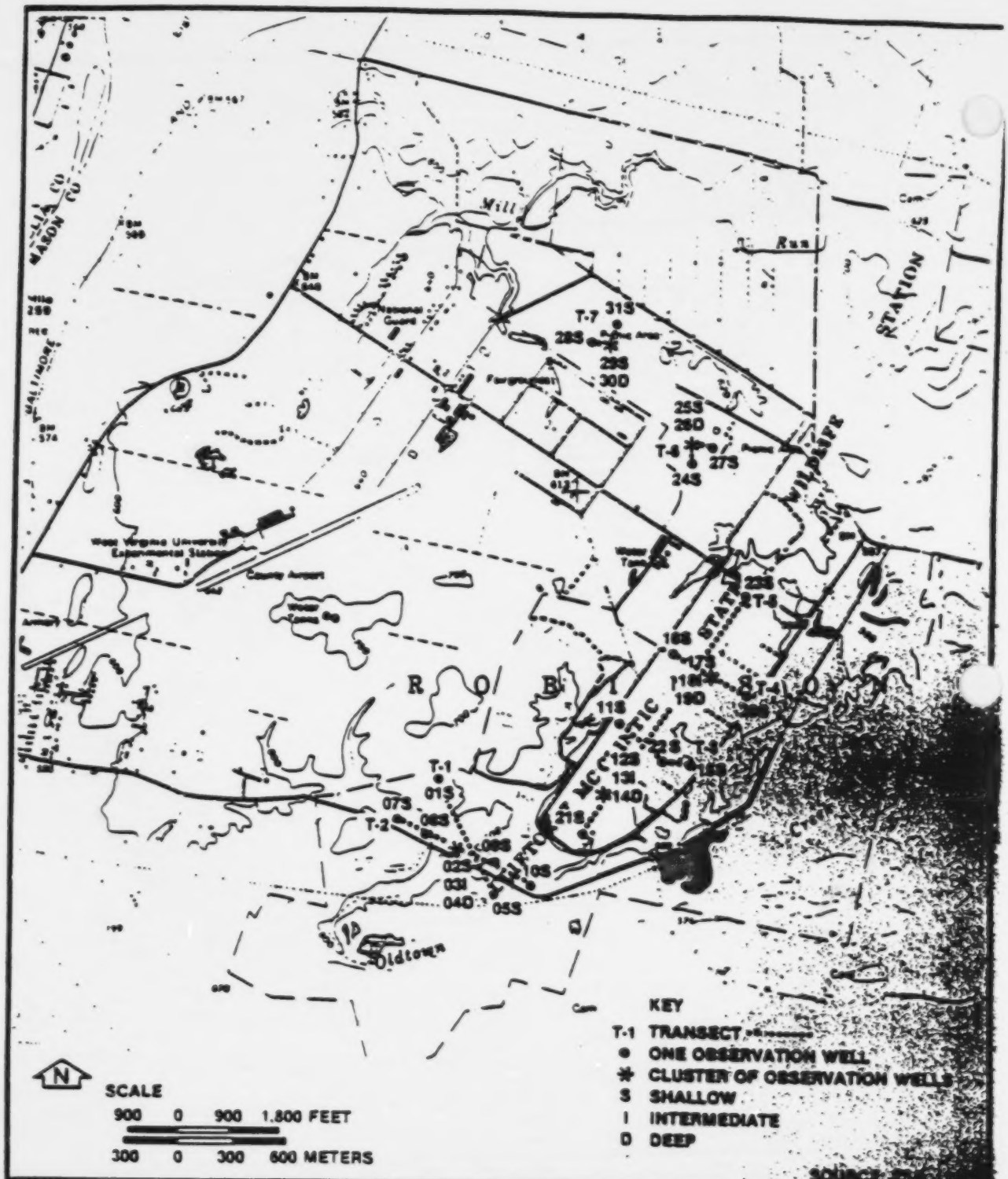

Figure 10, Page 30
OBSERVATION WELL LOCATIONS

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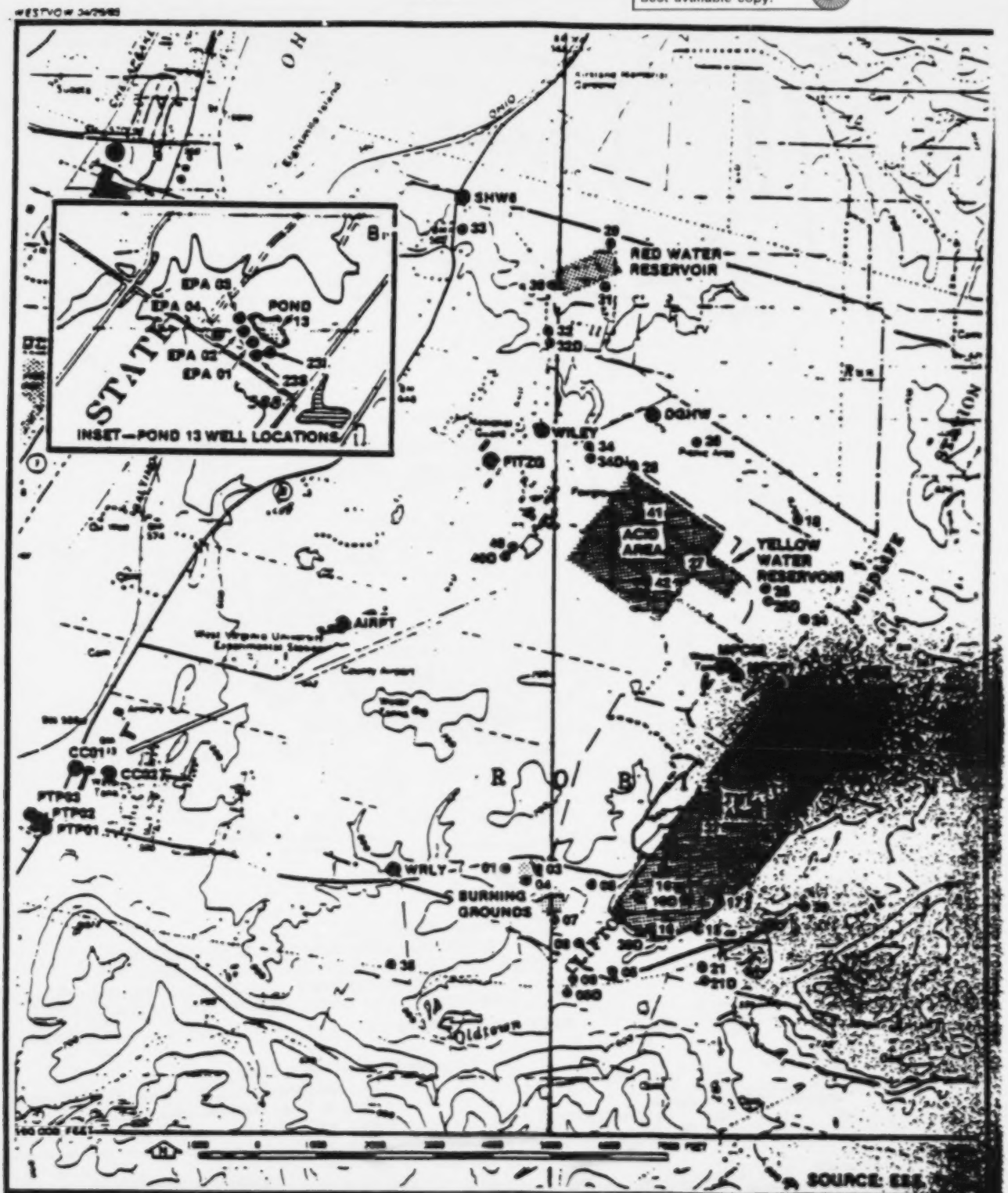

Figure 11, Page 31
LOCATIONS OF MONITOR WELLS, EPA WELLS, AND OFFSITE DOMESTIC WELLS

WEST VIRGINIA ORDNANCE WORKS
Remedial Investigation

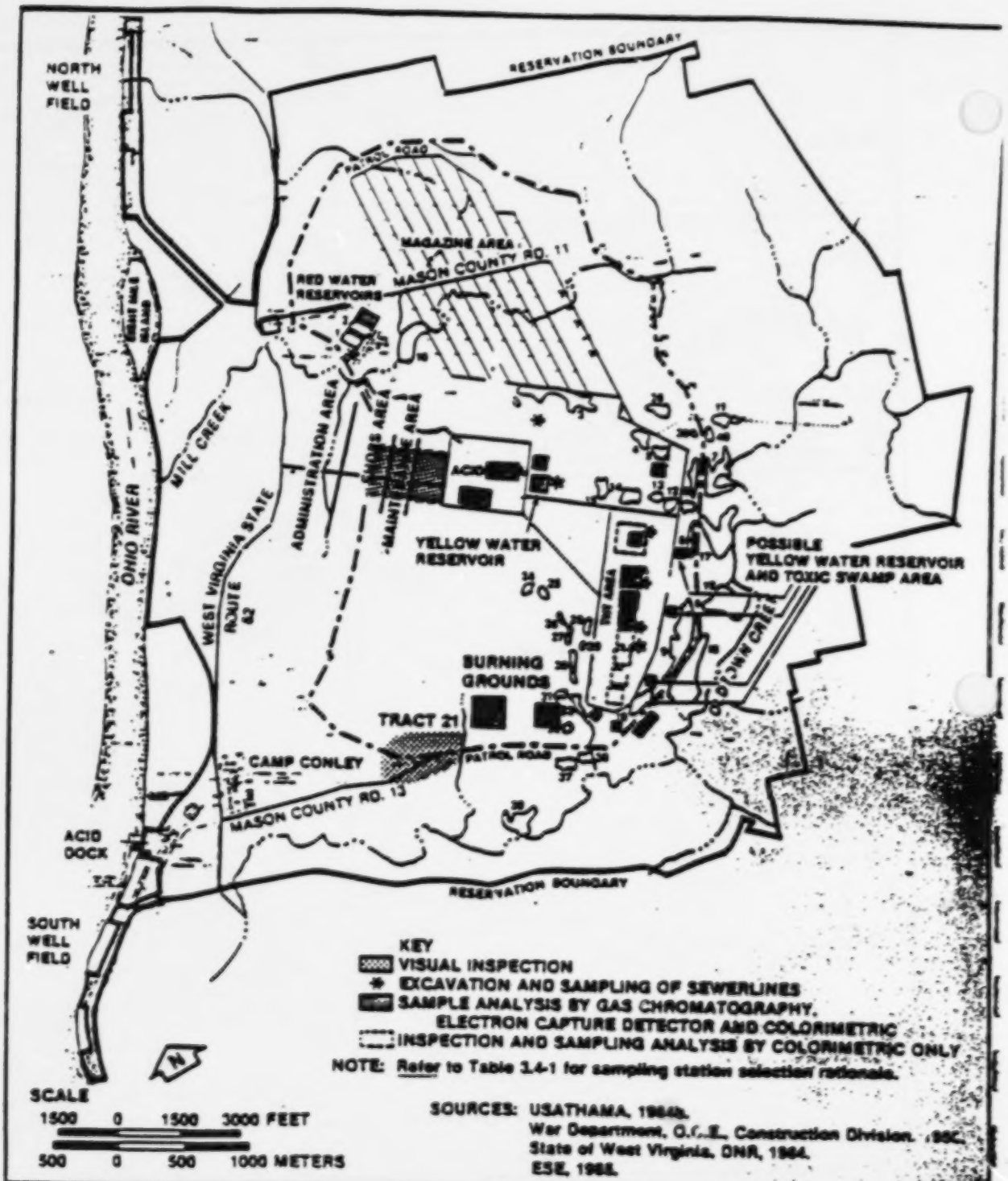

Figure 12, Page 32
LOCATIONS OF SOILS SAMPLING AREAS

WEST VIRGINIA ORDNANCE WORKS
Remedial Investigation

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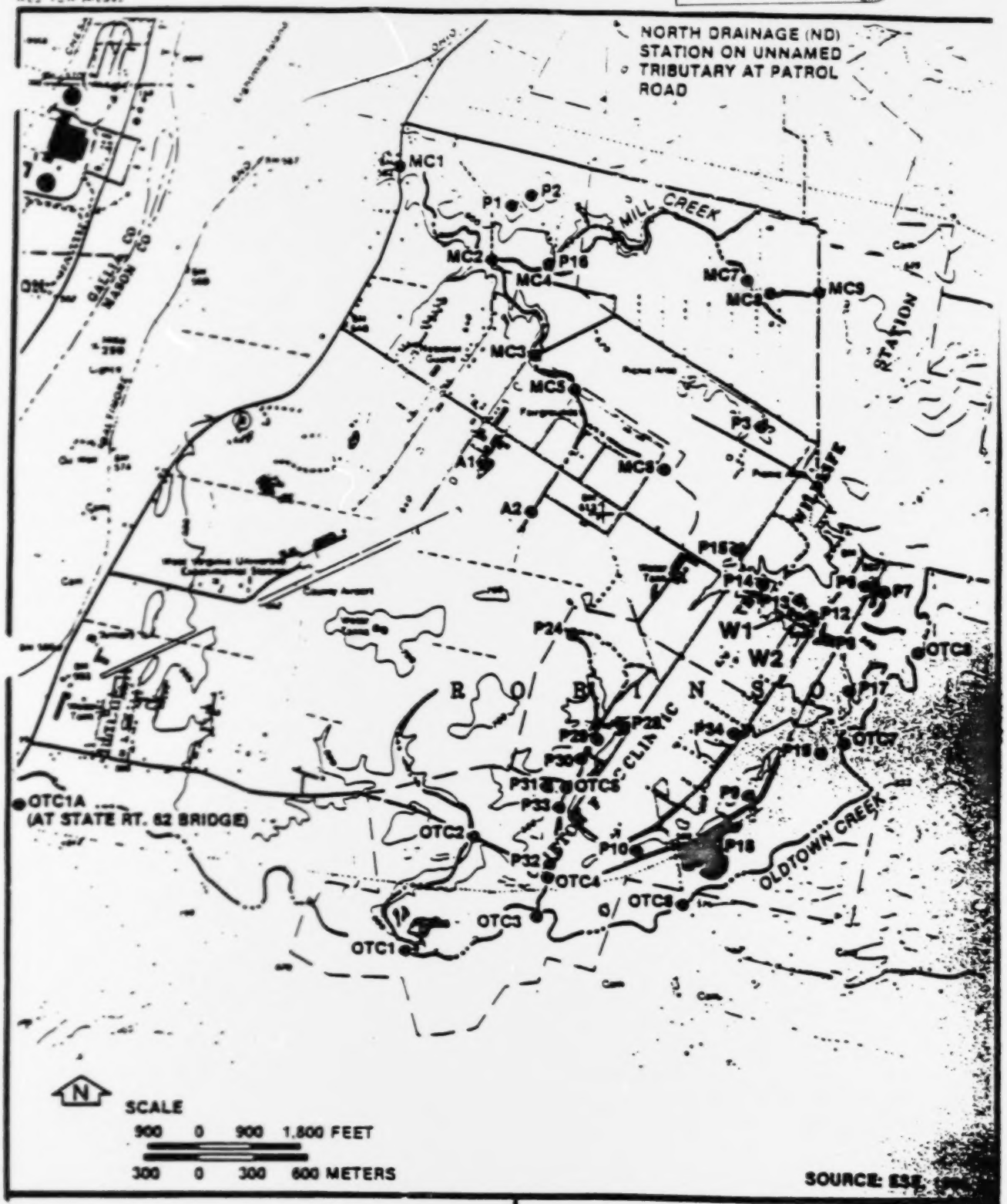

Figure 13, Page 33
LOCATIONS OF SURFACE WATER AND SEDIMENT SAMPLING STATIONS

WEST VIRGINIA ORDNANCE WORKS
Remedial Investigation

ENDANGERMENT ASSESSMENT

The basic remedial objectives of the DA were defined in their endangerment assessment (EA) report. The EA summarized and interpreted RI data in order to assess actual and/or potential harm to public health, welfare, or the environment from hazardous substances originating on WVOW. Consequently, the EA justified the need for remedial action and served to focus remedial action alternatives. Criteria for remediation were developed in consideration of all realistic exposure pathways by which people, wildlife, or aquatic life may be exposed to the contaminants. Criteria development was modeled on the Preliminary Pollutant Limit Value (PPLV) methodology developed at the U.S. Army Medical Bioengineering Research and Development Laboratory (USAMBRDL). The PPLV methodology represents an approach to criteria development based on site-specific exposure and risk assessment techniques and is documented by Small (1984). The criteria were developed under the assumption that McClintic Wildlife Station will continue to be managed as a hunting and fishing area with unrestricted access. Furthermore, the methodology assumes that recreational users should not be exposed directly or through game and fish to contamination levels that pose a significant risk. In addition, aquatic and terestrial biota should not be exposed to toxic concentrations.

Several key factors affect the exposure assessment. Hazardous concentrations of contaminants associated with the TNT Manufacturing Area, Burning Grounds Area, and Industrial Sewerlines are restricted to the McClintic Wildlife Station and would, under the No Action alternative, continue to be restricted. No residences will be constructed on the McClintic Wildlife Station. Ground water resources that have become contaminated are not now used for potable supply; the McClintic Wildlife Station is served by a municipal supply and overwhelming institutional constraints control against the use of ground water on the McClintic Wildlife Station as a future potable supply. The McClintic Wildlife Station is the most popular (i.e., heavily utilized) facility in West Virginia's state wildlife management system because of its proximity to the state's two largest cities, Huntington and Charleston. More importantly, the original deed transferring the property from DA to the State had a restriction requiring that the property be maintained as a wildlife preserve. Because of these constraints, it is clear that residences will not be constructed on McClintic Wildlife Station, nor will onsite ground water be used as a drinking water supply.

The criteria for residual contaminant levels are summarized in Table 4. By comparing actual contaminant levels with these criteria, the actual risks incurred by the exposed population have been estimated. The estimated lifetime cancer risk associated with regular use of the site and consumption of harvested game is estimated not to exceed 4×10^{-5}. Since the population exposed at the assumed levels is less than 200, the expected number of excess cancer incidences under the No Action alternative is less than 0.008. In other words, odds are about 100 to 1 that no excess cancers will occur as a result of contamination in the source areas. Noncarcinogenic health effects are not likely, with the possible exception of effects associated with 2,4,6-TNT which exceeds the derived criterion by a factor of 4.

Table 4. Acceptable Soil, Sediment, and Water Contamination Levels for WVOW Source Areas

Compound	McClintic Soils* [0.5 to 2 feet (ft)] (ug/g)	Pond Waters† (ug/L)	Pond Sediments† (ug/g)	Surficial Soils** (to 0.5 ft) (ug/g)
2,4,6-TNT	7,300	60	4	680
1,3,5-TNB	72,000	80	8	2,800
1,3 DNB	3,400	160	16	190
2,4-DNT				
10^{-6} risk	15	3.4	0.22	1.5
10^{-5} risk	150	34	2.2	15
2,6-DNT				
10^{-6} risk	3.1	0.67	0.53	0.31
10^{-5} risk	31	6.7	5.3	3.1
Total Nitroaromatics				
10^{-6} risk	500			50
10^{-5} risk	NA††			300

*Protects hunters from exposure by the plant-to-game pathway.
†Protects aquatic life and fishermen.
**Protects frequent McClintic Wildlife Station visitors from exposure by direct contact and inhalation of dust.
††Plants do not grow in soils containing total nitroaromatic contamination at concentrations that would result in 10^{-5} cancer risk.

Aside from an endangerment posed by the toxicity of nitroaromatic contamination to humans and wildlife, additional hazards exist at the site. Some sewerlines contain reactive wastes. These wastes should be removed or rendered nonreactive. Open manholes associated with sewerlines pose a safety hazard which should be remedied. Friable asbestos deposits in the Burning Grounds Area pose an inhalation hazard requiring remediation. Vegetation stress is evident in the Burning Grounds Area, and it appears that vegetation will not grow in soils containing more than 1,000 ug/g of total nitroaromatics.

Considering the findings of the EA, the following remedial objectives were defined to minimize or eliminate the endangerment associated with the source areas:

1. To eliminate safety hazards associated with reactive wastes: remove or render nonreactive all reactive wastes.
2. To achieve less than 10^{-6} individual lifetime excess cancer risk for avid hunters and their families or friends who consume meat from game that feed in contaminated areas: remove or cover the upper 2 ft of soil if total nitroaromatic contamination exceeds 500 ug/g.
3. To achieve less than 10^{-6} individual lifetime excess cancer risk for frequent visitors to the McClintic Wildlife Station who come into direct contact with surficial soils: remove or cover the upper 6 inches of soil if total nitroaromatic contamination exceeds 50 ug/g.

Achievement of these criteria will also eliminate the endangerment associated with other site contaminants since the other contaminants are found in association with high levels of nitroaromatic contamination. Achievement of Objective 3 will also mitigate potential impacts on aquatic biota associated with erosion and runoff from extreme storm events. All ponds stocked and used for fishing currently achieve the recommended surface water and sediment criteria designed to protect fishermen and aquatic life. It is necessary that any remedial actions taken will not result in exceedance of the acceptable contamination levels presented in Table 4.

To ensure that the individual lifetime excess cancer risk not exceed 10^{-5}, the objectives could be modified as follows:

- o No change for Objective 1.
- o Delete Objective 2: Plants cannot grow in soils contaminated with nitroaromatics at levels that would lead to a 10^{-5} risk level for game meat consumers nor would exposure to noncarcinogenic contaminants exceed acceptable levels as a result of plant uptake, regardless of soil contamination.
- o For Objective 3, change the criterion for removing or covering the upper 6 inches of soil from 50 ug/g to 300 ug/g total nitroaromatic contamination.

ALTERNATIVE DEVELOPMENT

The major objectives for the remedial action to be taken at the WVOW site are to eliminate the sources of contamination. This would involve preventing and/or reducing: a) infiltration through the sources; b) direct contact with contaminated soil; c) future contamination of ground water, and d) the degradation of surface waters. The requirements of CERCLA Section 104, EPA's mandate to protect the public health and welfare and the environment, determine the goals and level of response for the site.

In an effort to determine remedial alternatives for the subject site, feasible technologies were identified. These technologies were then screened to eliminate all but the most practicable and implementable ones. This screening considered: technical, public health, environmental, institutional, and cost considerations. Those technologies that passed the technology screening process were used to form remedial alternatives.

The remedial alternatives were developed using best engineering judgment to select a technology or group of technologies that best addresses the problems existing at the site to protect public health, welfare, and the environment. In an effort to provide a degree of flexibility in the final selection of a remedial action, alternatives covering a range of remedial action categories have been developed.

These categories are described below:

a) No action

b) Alternatives for treatment or disposal in an offsite facility.

c) Alternatives which attain public health and environmental standards as defined by CERCLA.

d) Alternatives which exceed public health and environmental standards as defined by CERCLA.

e) Alternatives which do not attain public health or environmental standards but will reduce the likelihood of present or future threat.

REMEDIAL ACTION ALTERNATIVES FOR AREAS OF STUDY (TNT MANUFACTURING AREA, BURNING GROUNDS AREA AND INDUSTRIAL SEWERLINES)

1.1 OFFSITE DISPOSAL ALTERNATIVES

1.1.1 Alternative 1A2

Alternative 1A2 for the TNT Manufacturing Area and the Burning Grounds involves the remediation of contaminated soil. Soil will be excavated and transported to a RCRA-permitted commercial incinerator that will accept nitroaromatics-contaminated soil in large quantities. The industrial sewerlines are not addressed, because no offsite facility was identified which would accept reactive materials for incineration.

The objective of this alternative is complete removal of all contaminated soil that contains nitroaromatic concentrations above the 10^{-6} risk levels. To achieve a 10^{-6} risk level for soils in the TNT Manufacturing Area and the Burning Grounds the following remedial objectives were established:

1. Remove, or render nonreactive, all reactive wastes;
2. Remove or cover the upper 2 ft of soil if total nitroaromatic contamination exceeds 500 ug/g; and,
3. Remove or cover the upper 6 inches of soil if total nitroaromatic contamination exceeds 50 ug/g.

The worst-case estimate for surficial contamination (>50 ug/g) at the TNT Manufacturing Area is approximately 9,000 ft^2 per TNT line, or 90,000 ft^2 total for the 10 lines. The estimates for the Burning Grounds is 48,980 ft^2.

The WVOW RI report (ESE, 1986a) indicates contamination was consistently below the 10^{-6} remedial objective of 500 ug/g at a depth of 50 centimeters (cm) (approximately 1.6 ft). Therefore, excavation to a depth of 1.6 ft was assumed sufficient to achieve the 10^{-6} cleanup objective to remove contamination within the upper 2 ft. Assuming a 25-percent swell factor upon excavation, approximately 10,325 cubic yards (cy) of soil will be removed and incinerated offsite.

Site Preparation--Mobilization operations associated with this alternative include:

1. Clearing and grubbing of heavy vegetation over an estimated 2.1 acres (0.21 acre per TNT line, 2 acres for Burning Grounds)
2. Performing a topographic survey of the contaminated area to document original elevations,
3. Installing trailers for decontamination and administration purposes,
4. Constructing access roads capable of supporting heavy equipment,
5. Constructing surface water controls, and
6. Extending utilities to these mobilized areas.

Access roads must be constructed to each building foundation to facilitate the movement of heavy earthmoving equipment. Access roads to the Burning Grounds will be reconstructed from a nearby existing gravel roadway. An estimated 3,500 linear ft of berms and/or swales will be constructed around the boundaries of contaminated areas to prevent surface water from entering or leaving the area during construction activities. Uncontaminated runoff will be routed around the area to existing drainageways. Onsite surface water will be channeled to collection points for evaporation and eventual offsite treatment (assuming significant runoff contamination). Ground water is not expected to be encountered during excavation because the uppermost aquifer is generally more than 15 ft below the land surface.

A decontamination station will be constructed to serve personnel, trucks, and equipment entering and leaving the contaminated areas. A concrete pad with a raised curb around the outer edges to collect rinsewaters is usually installed for this purpose. The decontamination station will be equipped with containers for disposal of contaminated Personnel Protective equipment, tubs and sprayers for personnel decontamination, a pressure washer for equipment and truck decontamination, and a pump to transfer spent washwater from the sump to a holding tank. The decontamination station will be centrally located to minimize the distance contaminated vehicles must travel onsite.

Special Conditions--The decision to accept this material by a commercial incineration facility is dependent on many factors. First, a waste profile sheet which gives detailed information on waste characteristics must be submitted to the facility. After reviewing this sheet, the commercial facility's management will decide if the waste is to be accepted and under what conditions.

One facility was identified which gave a "prescreening" acceptance of the waste, assuming nonreactivity. The facility, located approximately 750 mi from the WVOW site, is one of a few commercial incinerators capable of accepting the waste. One condition of acceptance is that the waste must be drummed. This condition, coupled with the long distance which vehicles must travel to deliver the waste, makes this alternative undesirable from a cost and safety standpoint.

A second factor to be considered is the availability of commercial incinerators at the time of actual cleanup. With increasing regulatory restrictions placed on the types of materials which can be landfilled, the demand for alternate disposal options will increase. This may result in a shortage of incinerator capacity in the near future, causing the offsite disposal of large volumes of soil to be infeasible.

Implementation--Implementation of this alternative requires excavation of soil with a backhoe and/or other earthmoving equipment. Backhoes under normal operating conditions will achieve greater than 100 cubic yards per hour (cy/hr) production rate; however, to avoid overstockpiling contaminated materials, excavation will coincide with loading and offsite transport rates.

The soil will be transported to a staging area where front-end loaders place the soil into containers or load the soil directly into trucks. Trucks will transport the material to a RCRA-permitted commercial incinerator after manifest requirements are met. Contaminated soil will be transported in accordance with DOT regulations covering transport of hazardous materials.

Confirmatory sampling and analysis of soil will be required to provide adequate assurances that soil has been removed to meet soil criteria objectives.

Asbestos and rubble will be loaded into trucks for transportation to a sanitary landfill. In-situ flaming will be required for all TNT residue in the Burning Grounds. Flaming entails the use of a hand held flamer to thermally decontaminate surface contaminants.

Closure--Closure of the site involves backfilling the excavated areas to original elevations, including compaction, final grading, and revegetation. Temporary facilities will be removed following decontamination. All wastes from the decontamination of equipment and personnel will be collected and transported to a RCRA-permitted disposal facility.

1.1.2 Alternative 1B1

Alternative 1B1 for the TNT Manufacturing Area involves the remediation of soil surrounding the Washer/Flaker building foundations, di/trinitrating houses, acid/fume recovery houses, diacid fortifier house, and nail houses. In the Burning Grounds, it involves the offsite disposal of contaminated soil. Soil will be excavated and transported to a RCRA-permitted offsite landfill for disposal. The Industrial Sewerlines are not addressed because offsite facility was identified which would accept reactive waste.

The objective of this alternative is the complete removal of all nitroaromatic concentrations above detectable levels (i.e., >2 ug/g, using field analyses). The worst-case estimate for surficial contamination is approximately 46,000 ft^2 per TNT line, or 460,000 ft^2 total for the 10 lines located at the TNT Manufacturing Area, and 166, 550 ft^2 at the Burning Grounds.

The excavation depth to achieve complete removal varies depending on the level of surficial contamination, due to the downward migration of various pollutant concentrations. Approximately 69,000 cy of contaminated soil must must be excavated and landfilled offsite, assuming a 25-percent swell factor.

The Washer/Flaker building foundations (approximately 27,000 ft^2) will be demolished, loaded into covered trucks, and transported to a sanitary landfill. These foundations must be removed to gain access to underlying soils. If necessary, the Washer/Flaker foundations will be decontaminated prior to offsite disposal using a hand-held flaming device. The contamination surrounding other foundations in the TNT Manufacturing Area, which was generally below 50 ug/g, is not considered high enough to justify foundation removal.

Site Preparation--Site preparation is the same as that described under Alternative 1A2 except:

1. The area to be cleared is approximately 15 acres; and
2. An estimated 16,000 linear ft of berms and/or swales will be required to control surface runon/runoff.

Local soil imported from offsite will be used to backfill the excavated areas. Approximately 69,900 cy of backfill will be placed and compacted to minimize post-closure settlement. The top 1 ft of backfill will consist of topsoil to facilitate the establishment of vegetative cover. The

fill will be graded to prevent ponding of surface water, and native grasses will be seeded and mulched to prevent erosion. Periodic post-closure inspection and maintenance of the revegetative areas and short-term land use restrictions will be required until the area is stable.

Implementation--Contaminated soil and foundations will be loaded from a staging area into covered trucks for offsite transport. Each truck will be decontaminated and its contents manifested before leaving the site. The nonreactive materials will be placed in double-lined, highly impermeable cells meeting the technical construction and operation requirements of RCRA. The landfill will also be EPA-approved for acceptance of CERCLA wastes. In situ flaming will be accomplished prior to excavation of the soils in the Burning Ground.

Confirmatory sampling and analysis of soil will be required to provide assurances that soil has been removed to meet criteria objectives.

Closure--Closure and post-closure activities are the same as those described under Alternative 1A2, except that 69,900 cy of backfill will be placed and compacted to minimize postclosure settlement.

Special Considerations--Before a commercial landfill will accept any nitroaromatics-contaminated soil, an analysis must be performed and a statement provided certifying that the material is nonreactive. One commercial landfill which gave a preliminary acceptance to the nonreactive soils was identified. The facility is under RCRA interim status and is located approximately 200 mi from the WVOW site. Contaminated soil can be accepted in bulk by this facility.

The disposal of contaminated soils into landfills over the next few years is questionable as the goal of the Federal hazardous waste management program is to reduce dependence on land disposal as a predominant management option.

1.1.3 Alternative 1B2

Alternative 1B2 for the TNT Manufacturing Area Land the Burning Grounds is the same as Alternative 1B1, except contaminated soil is removed to 10^{-6} risk levels. Approximately 10,325 cy of soil will be excavated from both areas and landfilled offsite. The Industrial Sewerlines are not addressed because no offsite facility was identified which would accept reactive wastes.

Site Preparation--Site preparation is the same as that described under Alternative 1A2.

Implementation--Implementation is the same as that described under Alternative 1B1.

Closure--Closure and post-closure activities are the same as those described under Alternative 1A2.

Special Considerations--Special considerations are the same as those described under Alternative 1B1.

1.2 ATTAINS REQUIREMENTS ALTERNATIVES

1.2.1 Alternative 2A

Alternative 2A for the TNT Manufacturing Area and the Burning Ground involves the remediation of contaminated soil. For the Industrial Sewerlines it involves excavation and onsite incineration and backfilling of all Sewerlines. Soil will be excavated and transported to an onsite incinerator. TNT residue will be in situ flamed prior to soil excavation. The substantive requirements of RCRA for incineration of hazardous wastes will be achieved. No permits will be required for this onsite CERCLA remedial action as per 40 CFR Part 300, Vol. 50, No. 224, Nov. 20, 1985.

The objective of this alternative is the complete removal of all contaminated soil above 10^{-6} risk levels, as described in Alternative 1A2. The estimated volume of soil requiring remediation is 11,000 cy. An additional 18,000 cy of uncontaminated soil excavation will be necessary to gain access to the Sewerlines.

Site Preparation--Site preparation for the TNT Manufacturing Area and Burning Grounds is the same as for Alternative 1A2, except additional trailers will be used for incineration operations. Fencing must be constructed around the incinerator site to limit public access. For the Industrial Sewerlines site preparation will be involve the the following:

1. Clearing and grubbing of heavy vegetation over an estimated 17 acres, assuring a 30 ft. corridor along the Sewerlines for equipment workspace;

2. Installation of trailers for decontamination and administrative purposes;

3. Construction of access roads for heavy equipment;

4. Surface water controls; and

5. Extenstion of utilities to these mobilized areas.

Berms will be constructed to divert runoff around excavated areas. A decontamination station will be established similar to Alt. 1A2.

Implementation--A transportable rotary kiln incinerator will be set up at the TNT Manufacturing Area. The solids incinerator module consists of a trailer-mounted rotary kiln, solids preparation and charging equipment, a burner, an air blower, and an ash discharge system.

Contaminated soil will be trucked to a temporary storage area near the incinerator. From there it will be loaded into the incinerator feed hopper and fed to the incinerator at a rate between 1 and 4 tons per hour (tons/hr). Ash formed during incineration is discharged into the kiln end breeching, where it falls into an ash discharge chute. A water-cooled screw conveyor subsequently carries the ash to a storage bin, where it is sampled for potential contaminants before being used as backfill in excavated areas.

The incinerator will be equipped with an afterburner to ensure complete combustion of kiln off-gases. A constant afterburner temperature will be maintained with auxiliary fuel oil or fuel gas. A baghouse will be necessary to control release of particulate material and acidic gas products of combustion. Periodic sampling of stack gases will be necessary to ensure compliance with air quality restrictions.

Organic destruction efficiencies of greater than 99.99 percent will be maintained as required by RCRA. Extraction procedure (EP) toxicity testing for leachable metals in the ash will be necessary to determine whether or not disposal at a RCRA-permitted landfill will be required.

For the Industrial Sewerlines excavation of contaminated sewerlines will be accomplished using two backhoes operating in tandem. The first backhoe will perform nonhazardous excavation to the contaminated sewerlines. The second backhoe will excavate contaminated sewerlines. A bulldozer will backfill the trench immediately ahead of the second backhoe in order to provide a working bench. Additional backfill may be necessary to completely fill the trench. The use of two backhoes in this manner will minimize any cross-contamination between contaminated media and uncontaminated soil which is used as backfill.

For safety purposes, the sewerlines may be wetted to reduce the potential for detonation from impact or confinement. Testwork and material evaluation will be required to establish the percent moisture needed to effect excavation and reliable conveyance of the materials. Blast shields will be employed during excavation.

Contaminated soil removed from the trench will be returned to the trench at locations that are greater than 2 ft below the land surface and covered with clean backfill.

Special precautions will be used in the handling, transport, and loading of reactive materials into the incinerator. If wetting or slurrying the materials is used to reduce the potential for detonation, these factors must be accounted for in the rotary kiln design and operating parameters. The water must be evaporated in the kiln, resulting in an additional heat requirement.

The sewerline material will be burned separately from any unreactive contaminated soil in accordance with RCRA requirements. In addition, organic destruction efficiencies of greater than 99.99 percent will be maintained. No permits are required for implementation of this alternative. Nonhazardous ash, as defined by EP toxicity testing for leachable metals, will be used as backfill.

Closure--Upon completion of incineration operations, the incinerator will be decontaminated and removed. Wastes generated from decontamination activities will be collected and hauled to a RCRA-permitted landfill for disposal.

For the Industrial Sewerlines--Closure involves backfilling of the excavated areas, compaction, final regrading, and revegetation. Preliminary investigations indicate that sufficient amounts of clean fill are available onsite. Open manholes will also be backilled for safety reasons. All wastes from decontamination of equipment and personnel will be collected and transported to a RCRA-permitted disposal facility. The top 1 ft of backill will be loosely compated topsoil to facilitate the establishment of vegetative cover. Maintenance of revegetated areas is the only post-closure activity predicted for this alternative. At closure, the incinerator will be decontaminated and removed from the site.

Ash from the incinerator will be used as backfill in the excavated areas. Fill material and topsoil will be brought in to fill gaps in the excavated areas and to facilitate proper contouring of the area. Native grasses will be seeded and mulched over the fill areas to assist in preventing erosion. Post-closure maintenance and inspection of these areas will be required.

Special Considerations--The characteristics of soils in the TNT Manufacturing Area and the Burning Grounds must be evaluated prior to implementation to determine the operating conditions, including feed rate, for the incinerator. A vendor estimate of 4 cy/hr was used in the FS.

For the Industrial Sewerlines one company which specializes in transportable, rotary kiln incinerators showed an interest in using its equipment for the incineration of potentially reactive sewerlines. Nevertheless, onsite incineration of this material may prove very difficult and/or costly due to the potential for explosioin as reactives are exposed to high temepratures.

1.2.2 Alternative 2B

Alternative 2B is similar to Alternative 2A, except that the contaminated soil is landfilled onsite instead of being incinerated. Contaminated soil will be removed to 10^{-6} risk levels, as described in Alternative 1A2. Approximately 10,325 cy of soil will be excavated and landfilled onsite, approximately 680 cy of sewerline will be flashed and landfilled. No permits for this onsite alternative will be required as per the NCP.

Site Preparation--Site preparation for the TNT Manufacturing Area and Burning Grounds is the same as for Alternative 1A2, except an additional 2 to 4 acres must be cleared at the landfill site. The landfill site must be fenced to limit public access. For the Industrial Sewerlines site preparation is the same as alternative 2A.

Implementation--The landfill will be designed and constructed to meet RCRA criteria, including a double-lined bottom and sides, double-leachate collection system, and double-lined cap. The landfill for the 10,325 cy of soil will cover approximately 2.5 acres. The landfill will be graded to minimize standing water and infiltration. Native grasses will be seeded and mulched to prevent erosion. Fencing will be placed around the landfill to limit public access.

Confirmatory sampling and analysis will be performed to provide assurance that contamination remaining in soils is below criteria. As the landfill is constructed, contaminated materials will be placed and compacted in 1-ft layers. Monitor wells will be installed around the landfill and ground water periodically analyzed in accordance with RCRA requirements. Permits are not required for the landfill because it represents an onsite CERCLA response action. For the Industrial Sewerline excavation will be the same as for Alternative 2A.

For the Industrial Sewerlines--Excavation will be the same as described for Alternative 2A. Contaminated soil removed from the trench will be returned to the trench 2 ft below the land surfaces and covered with clean backfill.

Flashing involves the use of a controlled, high-temperature flame to thermally degrade all contaminants. Flashing provides complete and rapid destruction of all residues contacted by the flame.

Once the sewerlines are brought to the surface, they will be wetted with water to desensitize explosive residues toward impact. Water containing dissolved and/or suspended explosives residue will be retained and treated as necessary. After the sewerlines are wetted, the sewerline pipes will be mechanically fractured and the explosive residue will be separated from the pipe. The residue will be placed in a remotely operated flashing device which will expose all residue to the flame front. Because of the high temperature of the flame, there should be rapid decomposition of all explosive residues present. Occasional turning of the materials may be required to expose all reactives to the flame.

After flashing, confirmatory sampling will be used to ensure that destruction of explosive residues is achieved. The ash from the flashing device will be placed in an onsite landfill, along with the contaminated sewerline pipe and small volumes of soils attached to the pipe.

Closure--Closure will include the removal of all temporary facilities, post-closure sampling and analysis of ground water from monitor wells, and post-closure landfill cover maintenance. The site must be registered as a hazardous waste disposal facility with permanent land use restrictions. Soil which was excavated to construct the landfill will be used as backfill in the TNT Manufacturing Area and Burning Grounds and will be seeded with native grasses for stability.

Special Considerations--There are no special consideration for this alternative relative to the TNT Manufacturing Area and the Burning Grounds.

For the Industrial Sewerlines--The design of the flashing device could be modeled after a Rockwell International® flamer used for sewerline decontamination at Alabamas Army Ammunition Plant (AAAP) (Rockwell, 1981). The determination of explosive concentration of the residue is required to optimize the dwell time of the flamer.

1.2.3 Alternative 2C

Under Alternative 2C, a multimedia cap will be used to isolate contaminated areas (exceeding 50 ug/g total nitroaromatics) from direct contact. Contaminated foundations remain in place and are capped along with the soil. The estimated area to be capped is approximately 2 acres. No permits will be required for this onsite CERCLA response action as per the NCP. TNT residue will be in situ flamed prior to capping. This alternative is not applicable to the reactive wastes in the Industrial Sewerlines.

Site Preparation--Site preparation is similar to that described for Alternative 1A2, except for the references to excavation.

Implementation--The design of multimedia caps will conform to EPA's guidance under RCRA, which recommends a 3-layer system consisting of an upper vegetative layer underlain by a drainage layer over a low-permeability layer. The cap functions by diverting infiltrating liquids from the vegetative layer through the drainage layer away from underlying waste materials. Local soils will be used to construct the vegetative (topsoil) layer and the low-permeability clay layer. Gravel, crushed stone, or a synthetic material will be utilized for the drainage layer. A synthetic liner will be placed above the clay to ensure the cap's integrity.

The site will be compacted and graded to promote runoff from the finished cap. The top 1 ft of soil will be loosely compacted to promote revegetation. Native grasses will be seeded and mulched to prevent erosion.

Closure--Closure will involve maintaining the existing land use restrictions to protect the capped area, and installing ground water post-closure monitor wells as required under RCRA. Post-closure monitoring of the ground water is required for 30 years under RCRA.

Special Considerations--Drainage ditches or berms will be installed upgradient of the capped areas to divert stormwater around the areas. Frequent inspection and maintenance will be required until vegetative growth can provide adequate support against erosion.

I.3 EXCEEDS REQUIREMENTS ALTERNATIVES

1.3.1 Alternative 3A

Alternative 3A, Onsite Incineration, is identical to Alternative 2A except that contaminated soil is removed to below detectable levels. Washer/Flaker foundations will be decontaminated if necessary by using a hand-held flaming device and disposed of in an offsite sanitary landfill. The total volume to be excavated and incinerated onsite is approximately 69,900 cy, as described in Alternative 1B1. No permits will be required for this onsite CERCLA response action as per the NCP.

For the Industrial Sewerlines, this Alternative is identical to Alternative 2A, except that soils beneath the sewerlines are removed to below detectable contamination concentrations.

Site Preparation--Site preparation will be the same as for Alternative 1B1. Additional trailers will be used for incineration, and the incinerator site must be fenced to limit public access. For the Industrial Sewerlines site preparation is the same as Alternative 2A.

Implementation--Implementation will be the same as for Alternative 2A, except that the time to implement will be much longer due to the increased quantity of soil to be processed.

Closure--Closure will be the same as for Alternative 2A.

Special Considerations--Special considerations will be the same as for Alternative 2A.

1.3.2 Alternative 3B

Alternative 3B, Onsite Landfilling, is the same as Alternative 2B except that contaminated soil is removed to below detectable levels. Contaminated foundations will also be removed, decontaminated with a hand-held flaming device if necessary, and disposed of in the onsite landfill. The total volume to be excavated and landfilled onsite is approximately 69,900 cy, as described in Alternative 1B1. No permits are required for this onsite CERCLA response action as per the NCP.

Site Preparation--Site preparation for this alternative is the same as for Alternative 1B1, except an additional 3 to 5 acres will be cleared for the landfill site.

Implementation--Implementation of this alternative will be the same as for Alternative 2B, except that the time to implement will be longer because of increased material volumes to be landfilled. For the Industrial Sewerlines implementation is the same as Alternative 2A.

Closure--Closure will be the same as for Alternative 2B. For the Industrial Sewerlines, closure is the same as Alternative 2A.

Special Considerations--There are no special considerations for this alternative description, in the TNT Manufacturing Area and the Burning Grounds. For the Industrial Sewerlines the same considerations as for Alternative 2B.

1.3.3 Alternative 3C

Alternative 3C, involving the use of a multimedia cap, is the same as Alternative 2C except that all areas with detectable nitroaromatics concentrations will be capped. No permits will be required for this onsite CERCLA response action as per the NCP. TNT residue will receive *in situ* flaming prior to installation of the cap in the Burning Grounds

Area. Asbestos and rubble will be disposed of in an offsite sanitary landfill. This alternative is not applicable to the Industrial Sewerlines because of reactive waste.

Site Preparation—Site preparation is similar to that described for Alternative 1B1. In addition, extensive backfilling and grading of eroded areas is required to provide a flat surface for capping.

Implementation—The design considerations for the multimedia cap are the same as those described for Alternative 2C. Rubble and asbestos will be removed and TNT residue will be flamed prior to capping.

Closure--Closure requirements are similar to those described under Alternative 2C.

Special Considerations—There are no special considerations for this alternative description.

1.4 CERCLA ALTERNATIVE

1.4.1 Alternative 4A

Alternative 4A involves soil cover which will be placed over all contaminated areas exceeding 50 ug/g total nitroaromatics to isolate the contaminants from direct contact. Contaminated foundations remain in place and are capped with the soil. The estimated area to be capped is 4.0 acre. No permits are required for this onsite CERCLA response action as per the NCP.

For the Industrial Sewerlines Alternative 4A involves excavation and flashing of the sewerlines, followed by backfilling the trench with resulting nonreactive burned materials. The products of burning will be placed over the contaminated materials to prevent direct contact. The estimated quantity of sewerlines to be burned is 680 cy. No permits will be required for this CERCLA response action, as per the NCP.

Site Preparation—Site preparation is the same as that described under Alternative 1A2, except for the references to the trailers and utilities required for mobilization. In addition, extensive backfilling and grading of eroded areas is required to provide a flat surface for capping. For the Industrial Sewerlines Site preparation is the same as that described for Alternative 2A.

Implementation—Onsite soils will be used to construct a soil cover over contaminated areas. The thickness of the cover will be a minimum of 2 ft. (1.5 ft. of clay and 5 ft. of soil). Rubble and asbestos will be removed and TNT residue will be flamed prior to capping. The site will be compacted and graded to promote runoff from the finished cover. Native grasses will be seeded and mulched to prevent erosion. For the Industrial Sewerlines the excavation and loading operations will be the same as those described for Alternative 2A. Sewerlines will be burned by a remotely operated flamer, as described in Alternative 2B. After burning, confirmatory sampling

and analysis will ensure that materials have been adequately treated to be returned to the trench.

Closure--Closure will involve maintaining existing wildlife station land use restrictions, post-closure inspection, maintaining the cover, and groundwater monitoring. For the Industrial Sewerlines closure of this alternative is the same as that described for Alternative 2A.

Special Considerations--There are no special considerations for this alternative description. Frequent inspection and maintenance of the cover will be required.

1.5 NO ACTION ALTERNATIVE

1.5.1 Alternative 5A

Under Alternative 5A, no remedial actions will be implemented at the TNT Manufacturing Area. This alternative will not improve site conditions nor will it mitigate the migration of site contaminants. This alternative has been included to establish a present site condition baseline. The baseline conditions are as stated in the WVOW RI report and the WVOW EA.

Alternative 5A includes a long-term monitoring program to provide information on the extent of contamination migration as a function of time. The monitoring program includes sampling and analysis of ground water, surface water, and seeps. Existing onsite monitor wells can continue to be used to monitor any possible future migration of contamination past the installation boundary toward potential human or environmental receptors.

This alternative does not address the public health and environmental considerations, but it does provide a means to identify future problems; it can be implemented easily, and no capital costs and low O&M costs are required.

ALTERNATIVE EVALUATION

Consistent with the National Contingency Plan (NCP) the alternatives were developed, screened, and evaluated in accordance with sections 300.68(g) through (i) of the NCP. Three broad criteria shall, as appropriate, be used in the initial screening of alternatives:

Criteria	Definition
Cost	For each alternative, the cost of implementing the remedial action must be considered, including operation and maintenance costs.

Acceptable Engineering Practices	Alternatives must be feasible for the location and conditions of the release, applicable to the problem and represent a reliable means of addressing the problem.
Effectivenesss	Those alternatives that do not effectively contribute to the protection of public health and welfare and the environment shall not be considered further.

Consistent with the NCP the DA screened their alternatives using six criteria: Cost, Public Health Concerns, Environmental Concerns, Technical Concerns, Community Response Concerns, and Operation and Maintenance (O/M).

ANALYSIS OF REMEDIAL ALTERNATIVES

Note: Table 5 contains costs and a summary of non-monetary considerations for all alternatives while Table 7 summarizes the scope of the alternatives in terms of cleanup level, volumes of waste and soil covers, etc.

The following alternatives were evaluated for each one of the three areas of study, namely the TNT Manufacturing Area, the Burning Grounds Area and the Industrial Sewerlines.

OFFSITE ALTERNATIVES

Alternative 1A2 - Offsite Incineration - Offsite Landfill

This alternative involves removal and offsite treatment of contaminated soils in an offsite commercial incinerator. For cost purposes, the offsite incinerator selected was Ensco Environmental Services located in Little Rock, AR.

This alternative involves the removal and offsite treatment of approximately 6,710 and 3,625 cy of soil from the TNT Manufacturing Area and Burning Grounds Area, respectively. The Industrial Sewerlines are not addressed because no offsite facility was identified which would accept reactive materials for incineration. The asbestos piles of the Burning Grounds Area will be removed and disposed of in an offsite sanitary landfill. This alternative reduces the cancer risk to less than the 10^{-6} criteria for the both areas mentioned above.

The useful life of this alternative is potentially infinite because nitroaromatic contaminants are totally destroyed. This alternative requires only periodic attention (maintenance of revegetated areas) upon implementation.

Alternative 1B1 - Offsite Landfill

This alternative involves the complete removal of contaminated soils in each area to detection limits (<2 ppm using field methods). The material will be transported approximately 200 mi to an offsite commercial landfill. The landfill selected for cost purposes was Cecos, International, located in Williamsburg, OH.

The volume of material to be removed varies considerably between sites. At the TNT Manufacturing Area, the estimated amount of soil to be excavated is 53,000 cy. Burning Grounds soils to be removed are estimated to be approximately 17,000 cy. There is no 1B1 Alternative for the Industrial Sewerlines because no commercial landfill was identified which would accept reactive or shock-sensitive materials. In situ flaming will be used to thermally destroy the TNT residue at the Burning Grounds Area prior to soil excavation.

This alternative reduces cancer risk to less than 10^{-6} level for the areas mentioned above. The useful life of this alternative is indefinite because contaminants are removed and no longer pose a threat to the community.

Alternative 1B2 - Offsite Incineration - Offsite Landfill

This alternative involves the excavation and offsite disposal to a RCRA-licensed landfill, similar to Alternative 1B1 except that the removal objective is to meet relevant requirements (instead of complete removal). Therefore, the volume of material from the TNT Manufacturing Area and Burning Grounds Area is approximately 10,300 cy. The asbestos piles are disposed of in an offsite sanitary landfill. Performance, reliability, safety and technical feasibility are the same as for Alternative 1B1.

ALTERNATIVES ATTAIN REQUIREMENTS

Alternative 2A - Onsite Incineration

This alternative involves the removal and onsite treatment of the contaminated soil in an onsite incinerator. The ash from the incinerator, if determined nonhazardous according to EP toxicity characteristics for metals, will be used as backfill in the excavated areas. Permits are not required for the operation of the incinerator. An estimated 6,710 cy and 3,625 cy of soil will be incinerated from the TNT Manufacturing Area and Burning Grounds Area, respectively. In addition, an estimated 680 cy of contaminated sewerlines will be incinerated, for a total volume of approximately 11,000 cy from the three areas. As in previous cases the asbestos piles will be disposed of in an offsite sanitary landfill.

The level of treatment is to achieve applicable (10^{-6}) criteria for the site. Removal and subsequent destruction of organic contaminants are permanent and irreversible, resulting in an infinite useful life for this alternative. Monitoring of onsite incineration effectiveness will be required.

Alternative 2B - Onsite Landfill

This alternative involves the removal of contaminated soil from the TNT Manufacturing Area and Burning Grounds Area and placing it in an on-site landfill constructed to meet RCRA standards. Permits will not be required for the construction and operation of the landfill. Sewerlines will be flashed using a remotely operated flamer and subsequently placed in the landfill with the contaminated sewerline pipe. An estimated 11,000 cy of soil and sewerlines must be landfilled to meet the objectives of these alternatives. Asbestos and rubble will be disposed of in the onsite landfill along with the soils.

The useful life of this technology is infinite because contaminants are destroyed. Post-closure O&M of the landfill must occur perpetually after closure to ensure its integrity. This method reduces cancer risk to 10^{-6}.

Alternative 2C - Multimedia Cap

This alternative involves applying a multimedia cap to all areas of contaminated soil where the surficial soil concentration exceeds 50 ppm. Using this criterion, an estimated 15,194 square yards (sq yd) (i.e., 3.1 acres) of soil must be capped at the WVOW site. Contaminated sewer-lines must be removed to meet attainable requirement objectives; therefore, there is no 2C Alternative for the sewerlines. The TNT residue must be in situ flashed prior to cap installation. Asbestos and rubble will be disposed of in a offsite landfill. The multimedia cap, which is designed to RCRA specifications, can last indefinitely if properly maintained. O&M requirements include regrading, revegetation, and maintenance of cracks occurring in the cover from climatic stress or burrowing animals. Post-closure maintenance of the cap must occur perpetually to ensure its integrity. This method reduces cancer risk to 10^{-6}.

ALTERNATIVES EXCEED REQUIREMENTS

Alterative 3A - On site Incineration

This alternative includes the removal of contaminated soil to detectable levels and treatment in an onsite incinerator. Incinerator ash, if determined to be nonhazardous through EP toxicity testing, will be used as backfill. To meet the alternative objectives, an estimated 99,680 cy of soil and sewerlines must be removed and incinerated from the three areas of concern. The contaminated soils underlying the sewer-lines will be removed to a depth necessary to achieve complete removal of nitroaromatics contamination. Reduces cancer risk to less than 10^{-6}.

Alternative 3B - Onsite Landfill

Under this alternative, approximately 99,680 cy of contaminated soil will be excavated and disposed of in an onsite landfill constructed to RCRA standards. The reactive sewerline materials must be flashed before placement in the onsite landfill. Reduces cancer risk to 10^{-6}. The facility will require significant O&M perpetually after closure. Performance, reliability, implementability and technical feasibility are the same as the 2B Alternatives.

Alternative 3C - Multimedia Cap

This alternative involves the placement of a multimedia cap over all areas where the surficial soil exceeds nondetectable levels. Using this criterion, an estimated 69,811 sq yd (i.e., 14.4 acres) must be capped in the TNT Manufacturing Area and Burning Grounds Area. The Industrial Sewerlines are not addressed under the 3C Alternative. Performance, reliability, implementability and technical feasibility are the same as the 2C Alternatives.

CERCLA REQUIREMENTS
Alternative 4A Alternative

This alternative involves the in situ flaming of the reactive TNT residue on the surface of the Burning Grounds Area followed by the installation of 2 ft. soil cover over areas with greater than 50 ppm total nitroaromatics contamination. The same criteria will be used to cap areas in the TNT Manufacturing Area. A total of approximately 15,194 cy of soil will be used for the caps. Asbestos and rubble will be disposed of in an offsite landfill. Reactive sewerlines will be excavated, flashed, and backfilled into the trenches out of which they came. All contaminated soil at the surface exceeding 50 ppm will be covered. This action will involve approximately 680 cy of soil.

The useful life of this alternative is based largely on adequate maintenance of the caps. This alternative eliminates exposure to contaminants and endangerment to public health.

NO-ACTION ALTERNATIVE
Alternative 5A - No Action

Under Alternative 5A, no remedial actions will be implemented at the three areas of concern. However, a monitoring program will be implemented to provide information on the extent of contamination as a function of time. The monitoring program includes annual sampling and analysis of ground water wells (12), seeps (3), and surface waters (2) in the TNT Manufacturing Area; sampling and analysis of ground water wells (6) and surface water stations (4) in the Burning Grounds Area; and, monitoring of the ground water wells along the Industrial Sewerlines (5).

This alternative does not reduce or eliminate any of the impacts resulting from site contaminants. The sampling of surface and ground waters will be from existing sample stations and wells, so that no construction is necessary. Unacceptable exposure limits to nitroaromatics will exist.

CONSISTENCY WITH OTHER ENVIRONMENTAL LAWS

Alternatives were examined in light of applicable or relevant and appropriate Federal, State and local environmental program requirements and in light of all CERCLA requirements.

The remedial actions proposed will be coordinated with the State to ensure that the water and air quality will meet all applicable standards.

PREFERENCE FOR PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT

The alternatives evaluated for the site included a range of alternatives from no action (Alternative 5A) to complete elimination of the waste through on-site incineration (Alternative 3A). In evaluating these alternatives a preference was given to considering treatment alternatives which provided for a reduction in the toxicity, mobility or volume of the waste. Beyond incineration an alternative technology which reduces the toxicity and volume of the nitroaromatic wastes at the site is flashing/ flaming of the wastes. While this process will not be done to a level which permanently eliminates wastes at the site, it will reduce levels of nitroaromatics below a 10^{-6} cancer risk level and is therefore protective of public health. Furthermore, it is approximately 25 times more economical in present worth costs than complete reduction through incineration. Therefore, it is our belief that the flashing/ flaming option followed by a soil cover provides a permanent solution to the maximum extent practicable.

RECOMMENDED ALTERNATIVE

Section 300.68(j) of the National Contingency Plan (NCP) states that the appropriate extent of remedy shall be determined by the lead agency's selection of a remedial alternative which the agency determines is cost-effective (i.e., the lowest cost alternative that is technically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of public health, welfare and the environment). In selecting a remedial alternative, EPA must consider all environmental laws that are applicable. Based on the evaluation of the cost effectiveness of each proposed alternative, the analysis contained above and the comments received from the public and the West Virginia Department of Natural Resources (WVDNR) we recommend the following remedial alternative for the three source areas:

Alternative 4A

1. In situ flaming of the reactive TNT residue on the surface of the Burning Grounds Area followed by the installation of a 2 ft. soil cover (1.5 ft. clay and 5 ft. soil) over areas with greater than 50 ppm total nitroaromatics contamination.

2. Installation of a 2 ft. soil cover over areas in the TNT Manufacturing Area with greater than 50 ppm total nitroaromatics contamination.

3. Asbestos from the Burning Grounds Area will be disposed of in an offsite facility which will be identified during design. Transportation of this material will be in covered trucks using local roads.

4. Reactive sewerlines will be excavated, flashed, and backfilled in the trenches from which they were removed. All contaminated soil exceeding 50 ppm at the surface will be covered to achieve the 10^{-6} risk level. The sewerline will be rendered unreactive by flashing and buried deeper than 2 ft. below ground surface.

5. A health and safety plan will be implemented for all activities described in the ROD. During excavation, flashing and construction activities, air monitoring will be conducted to ensure the safety of the onsite workers as well as to protect the residents and wildlife living nearby the construction areas.

6. A Wetland Assessment will be performed, before construction activities, to establish the potential existance of wetlands in the areas where remedial actions are to be taken. It is currently anticipated that this assessment will be accomplished during a one day walk through by an experienced biologist/wetlands ecologist.

OPERATION AND MAINTENANCE

Operation and maintenance (O/M) at the site under this first operable unit will consist of periodic checks and repairs, as necessary to maintain the soil cap and vegetative cover at each source area. Post-closure groundwater monitoring consistent with RCRA requirements must also be conducted. A groundwater monitoring plan for such will be developed during design.

The current deed restrictions established when the property was transferred from the DA to the State mitigate against the private use of the McClintic Wildlife Station for development and consequently the State of West Virginia has the incentive and authority to maintain the land in this use. While not critical to the success of the selected remedy, strengthening the deed restrictions should be considered in the future to assure that any subsequent agreement between DA and the State will not alter the current restraints scenario. The DA itself or by agreement with the State of West Virginia will ensure that O/M at the site will be accomplished.

EVALUATION OF ALTERNATIVES NOT SELECTED

A summary of the detailed technical, environmental, institutional, public health, and cost evaluations is presented for each area of concern in Table 5.

Selection of a remedial alternative is specified in Sec. 300.68(i)(1) of the NCP, which states:

> Except as provided in Sec. 300.68(i)(5), this will require selection of a remedy that attains or exceeds applicable or relevant and appropriate Federal public health and environmental requirements that have been identified for the specific site.

Federal and State public health and evironmental requirements are identified in Table 6. All of the alternatives, except the No Action 5A Alternative, meet or exceed these requirements.

All alternatives for each of three areas, except the No Action 5A Alternative, meet or exceed the remedial action criteria and objectives established by the Endangerment Assessment. These criteria and objectives are to:

1. Remove or render unreactive all reactive wastes, and

2. Remove or cover the upper 2 ft. of soil if total nitroaromatic contamination exceeds 50 ppm to achieve less than 10^{-6} individual lifetime cancer risk.

Environmental and public health impacts of nitroaromatic contamination are eliminated or minimized to acceptable levels by implementation of these alternatives. An onsite landfill or multimedia cap will require long-term monitoring and maintenance. The general impetus for installing a landfill or multimedia cap, designed to meet RCRA standards, is to prevent ground water contamination. As noted on pages 27 and 28, ground water beneath the source areas at WVOW are either not a problem (TNT Manufacturing Area) or are unaffected (Burning Grounds Area). This standard, therefore, does not provide the basis to justify the extra expense required to implement these alternatives. None of the alternatives, except No Action 5A Alternative, will have a significant adverse effect on the continued use of the site as a wildlife preserve. Additional land use restrictions will probably be required for the areas containing an onsite landfill or multimediacapped contaminated soil to protect the integrity of these structures. Existing wildlife station land use restrictions are adequate to protect the integrity of the 4A alternative soil cover - no additional restrictions are required. These restrictions will not affect the operation of McClintic Wildlife Station, as the affected areas represent less than 0.3 percent of the station's land.

Table 5 Source Control Alternatives Summary for the TNT Manufacturing Area

Alternative	Cost ($1,000) Capital	Present Worth	Public Health Concerns	Environmental Concerns	Technical Concerns	Community Response Concerns	Other
1B1-Offsite Landfill	16,300	16,300	Eliminates exposure pathways. Reduces cancer risk to less than 10^{-6}.	Environmental impacts eliminated.	Proven technology. Future regulatory constraints.	Increased traffic Acceptable.	Removal of waste to RCRA-permitted facility. Long term monitoring not required.
1A2-1B2-Offsite Incineration-Offsite Landfill	21,957 2,509	21,957 2,509	Minimizes exposure pathways. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Acceptable levels remain.	Proven technology. Future regulatory constraints.	Increased traffic. Acceptable.	Removal of waste to RCRA-permitted facility. Long term monitoring not required.
2A-Onsite Incineration	4,206	4,206	Minimizes exposure pathways. Contamination destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Acceptable levels remain.	Proven technology. Not limited by site conditions.	Moderately acceptable.	Monitoring of onsite incineration effectiveness required.
2B-Onsite Landfill	1,054	1,111	Minimizes exposure pathways. Contamination not destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Permanent onsite facility.	Long-term maintenance required.	Moderately Acceptable.	Long-term monitoring and potential leachate management required.
2C-Multimedia Cap	1,159	1,178	Minimizes exposure pathways. Contamination not destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Permanent onsite facility.	Long-term maintenance required.	Acceptable.	Long-term monitoring required.

Table 5 Source Control Alternatives Summary for the TNT Manufacturing Area (Continued)

Alternative	Cost ($1,000) Capital	Present Worth	Public Health Concerns	Environmental Concerns	Technical Concerns	Community Response Concerns	Other
3A-Onsite Incineration	26,283	26,283	Eliminates exposure pathways. Contamination destroyed. Reduces cancer risk to less than 10^{-6}.	Environmental impacts eliminated.	Proven technology. Not limited by site conditions.	Moderately acceptable.	Long-term monitoring not required.
3B-Onsite Landfill	5,588	5,880	Eliminates exposure pathways. Contamination not destroyed. Reduce cancer risk to less than 10^{-6}.	Environmental impacts minimized. Permanent onsite facility.	Long-term maintenance required.	Moderately acceptable.	Long-term monitoring and potential leachate management required.
3C-Multimedia Cap	4,783	4,868	Minimizes exposure pathways. Contamination not destroyed. Reduces cancer risk to less than 10^{-6}.	Environmental impacts minimized. Permanent onsite facility.	Long-term maintenance required.	Acceptable.	Long-term monitoring required.
4A-Soil Cover	623	642	Minimizes exposure pathways. Contamination not destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Permanent onsite facility.	Long-term maintenance required.	Acceptable.	Lowest cost alternative. Meets CERCLA goals. Long-term monitoring required
5A-No Action	0	0	Unacceptable exposure to nitroaromatics.	Exposure pathways remain. Use of wildlife preserve adversely affected.		Unacceptable.	

Table 5 Source Control Alternaives Summary for the Burning Grounds Area (Continued)

Alternative	Cost ($1,000) Capital	Present Worth	Public Health Concerns	Environmental Concerns	Technical Concerns	Community Response Concerns	Other
1B1-Offsite Landfill	5,575	5,575	Eliminates exposure pathways. Reduces cancer risk to less than 10^{-6}.	Environmental impacts eliminated.	Proven technology. Future regulatory constraints.	Increased traffic. Acceptable.	Removal of waste to RCRA-permitted facility. Long-term monitoring not required.
1A2-1B2-Offsite Incineration-Offsite Landfill	10,720 1,268	10,720 1,268	Minimizes exposure pathways. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Acceptable levels remain.	Proven technology. Future regulatory constraints.	Increased traffic. Acceptable.	Removal of waste to RCRA-permitted facility. Long term monitoring not required.
2A-Onsite Incineration	2,380	2,380	Minimizes exposure pathways. Contamination destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Acceptable levels remain.	Proven technology. Not limited by site conditions.	Moderately acceptable.	Monitoring of onsite incineration effectiveness required.
2B-Onsite Landfill	621	659	Minimizes exposure pathways. Contamination not destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Permanent onsite facility.	Long-term maintenance required.	Moderately acceptable.	Long-term monitoring and potential leachate management required.
2C-Multimedia Cap	603	612	Minimizes exposure pathways. Contamination not destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Permanent onsite facilit	Long-term maintenance required.	Acceptable.	Long-term monitoring required.

Table 5 Source Control Alternatives Summary for the Burning Grounds Area (Continued)

Alternative	Cost ($1,000) Capital	Present Worth	Public Health Concerns	Environmental Concerns	Technical Concerns	Community Response Concerns	Other
3A-Onsite Incineration	8,453	8,453	Eliminates exposure pathways. Contamination destroyed. Reduces cancer risk to less than 10^{-6}.	Environmental impacts eliminated.	Proven technology. Not limited by site conditions.	Moderately acceptable.	Remedial action effectiveness monitoring required.
3B-Onsite Landfill	1,909	2,013	Eliminates exposure pathways. Contamination not destroyed. Reduces cancer risk to less than 10^{-6}.	Environmental impacts minimized. Permanent onsite facility.	Long-term maintenance required.	Moderately acceptable.	Long-term monitoring and potential leachate management required.
3C-Multimedia Cap	1,631	1,669	Minimizes exposure pathways. Contamination not destroyed. Reduces cancer risk to less than 10^{-6}.	Environmental impacts minimized. Permanent onsite facility.	Long-term maintenance required.	Acceptable.	Long-term monitoring required.
4A-Soil Cover	333	342	Minimizes exposure pathways. Contamination not destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Permanent onsite facility.	Long-term maintenance required.	Acceptable.	Lowest cost alternative. Meets CERCLA goals. Long-term monitoring require.
5A-No Action	0	0	Unacceptable exposure to nitroaromatics.	Exposure pathways remain. Use of wildlife station adversely affected.		Unacceptable.	

Table 5 Source Control Alternatives Summary for the Industrial Sewerlines (Continued)

Alternative	Cost ($1,000) Capital	Present Worth	Public Health Concerns	Environmental Concerns	Technical Concerns	Community Response Concerns	Other
2A-Onsite Incineration	1,306	1,306	Minimizes exposure pathways. Contamination destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Acceptable levels remain.	Proven technology. Not limited by site conditions.	Moderately acceptable.	Monitoring of onsite incineration effectiveness required.
2B-Onsite Landfill	949	968	Minimizes exposure pathways. Contamination not destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Acceptable levels remain.	Long-term maintenance required.	Moderately acceptable.	Long-term monitoring and potential leachate management required.
3A-Onsite Incineration	14,300	14,300	Eliminates exposure pathways. Contamination destroyed. Reduces cancer risk to less than 10^{-6}.	Environmental impacts eliminated.	Proven technology. Not limited by site conditions.	Moderately acceptable.	Remedial action effectiveness monitoring required.
3B-Onsite Landfill	3,518	3,680	Minimizes exposure pathways. Contamination not destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Permanent onsite facility.	Long-term maintenance required.	Moderately acceptable.	Long-term monitoring and potential leachate management required.
4A-Burn Backfill	851	851	Minimizes exposure pathways. Contamination not destroyed. Reduces cancer risk to 10^{-6}.	Environmental impacts minimized. Permanent onsite facility.	Proven technology	Moderately acceptable.	Lowest cost alternative. Meets CERCLA goals. Long-term monitoring required
5A-No Action	0	19	Unacceptable exposure to nitroaromatics.	Exposure pathways remain. Use of wildlife station adversely affected.	--	Unacceptable.	--

Table 6. Summary of Applicable and Relevant or Appropriate Laws, Regulations, Policies, and Criteria

Law, Regulation, Policy, or Criterion	Analysis
Federal	
RCRA	Treatment and disposal of materials removed from WVOW to an offsite facility will be in compliance with current RCRA regulations issued in the HSWA of 1984. Onsite treatment and disposal operations will be in accordance with the substantive technical requirements of RCRA.
National Ambient Air Quality Standards (NAAQS)	Implementation of alternatives that include onsite incineration will result in the emission of pollutants into the air. The use of air pollution control equipment will minimize the effect of incinerator emissions on existing air quality. Incinerator performance standards will be attained, but permits will not be required. Because the emissions from surface flashing are largely uncontrollable, air quality standards may not be met during flashing operations. Particulate emissions during excavation will occur, although dust palliatives will be used to minimize fugitive dust. Onsite personnel, however, will be adequately protected.
DOT Hazardous Materials Transport Rules	The transport of hazardous materials to offsite facilities will be in compliance with these rules, including use of properly constructed and marked transport vehicles, a licensed transporter, and hazardous waste manifests.
Federal Water Quality Criteria (FWQC)	During the implementation of alternatives, the substantive requirements and standards of FWQC in creeks that drain the site and other downgradient surface water will be attained.
National Environmental Policy Act (NEPA)	The RI/FS process designed by EPA regulations and guidance and as conducted at this site is functionally equivalent to the requirements of NEPA.

Table 6. Summary of Applicable and Relevant or Appropriate Laws, Regulations, Policies, and Criteria
(Continued, Page 2 of 2)

Law, Regulation, Policy, or Criterion	Analysis
Asbestos Disposal Rule (40 CFR, Part 61, Subpart M)	Since asbestos is present in the Burning Grounds Area, alternatives for asbestos disposal will meet or exceed this rule. Offsite alternatives will be in full compliance; onsite alternatives will meet technical requirements.
State of West Virginia Water Quality Standards (WVWQS)	In implementing alternatives, WVWQS in creeks that drain the site and other downgradient surface water will be considered. The substantive requirements will be complied with and the standards attained.
West Virginia Solid Waste Regulations	Implementation of alternatives will meet the West Virginia regulations for noncontaminated materials taken to offsite sanitary landfills.
West Virginia Hazardous Waste Regulations	Implementation of alternatives will meet the requirements of current regulations, including manifest requirements.
West Virginia Air Pollution Control Commission (WVAPCC) Administrative Regulations	The substantive technical requirements of these regulations will be met, and the standards and criteria of New Source Performance Standards (NSPS) will be met. The requirements of the open burning regulations will also be met.
West Virginia Pollution Discharge Elimination System (WVPDES) Regulations	The substantive technical requirements of these regulations will be complied with, and the standards and criteria for point source discharges will be met in implementation of the alternative.
Clean Water Act - Section 404 (Wetlands)	During the initial stages of design a wetlands assessment will be conducted to establish the existence of wetlands and define potential impacts. If impacts are foreseen mitigative measures can be factored into the remedial design to protect the wetland ecology.

Alternative 4A, the soil cover, is the least costly alternative (achieving response objectives) at a present-worth cost of $642,000 for the TNT Manufacturing Area and $342,000 for the Burning Grounds Area. This alternative achieves the response objectives of protecting against direct contact and minimizing exposure pathways. The cancer risk is reduced to the 10^{-6} risk level. Alternative 1B1, 3A and 3B could reduce this potential to below the 10^{-6} risk level, but at costs between 5 and 25 times greater. The exposure pathways could be entirely eliminated, assuming that all contamination is removed, through implementation of their alternative; however, since direct human contact is the only endangerment pathway, the soil cover (Alternative 4A) adequately provides this protection.

In all cases, the technologies involved in the alternatives are technically acceptable and proven, and no alternative offers a significant technical advantage to achieve response objectives or an advantage based on specific site condition at WVOW. Alternative 4A does require long-term care to maintain the integrity of the cover. Periodic groundwater monitoring will also be required after implementation.

The least costly alternative for the Industrial Sewerlines is Alternative 4A, which consist of burning the sewerlines and then backfilling the area. This alternative meets the objectives of eliminating the reactivity of the sewerlines and protecting human receptors from the exposure. Alternative 2A costs $1,306,000, an increase just less than twice that of Alternative 4A. Both alternatives are comparable in all other areas evaluated.

The implementation, however, of an onsite incinerator for a small volume area is not as practical or viable an alternative as for larger sites. In addition, a sensitivity analysis discussion has demonstrated the extreme variation of cost of this alternative with slight changes in quantity. Therefore, any increase in estimated volume of contaminated sewerlines would significantly increase cost. For the flashing/onsite landfill alternative, it would cost approximately 4 times more to exceed the standard. For onsite incineration alternative, exceeding standards could cost 10 times more. Because of the significant differential in cost and lack of adequate quantification of the extent of soil contamination below the sewerlines, exceeding standards in these alternatives is difficult to justify.

Table 7 Alternatives - TNT Manufacturing Area

Alternative	Cleanup Level	Excavated Volume (cy)*	Treatment		Disposal/ Treatment Level (percent)	Disposal		Capped Area (sq yd)	Backfill		Post-Closure Monitoring	Years Mobilized
			Method	Volume (cy)		Site	Volume (cy)		Source	Volume (cy)		
Offsite 1A2	10^{-6}	6,710	Incinerate	6,710	99.99	Ensco, AR	6,710	0	Offsite	6,710	None	1
Offsite 1B1	<detection	53,000	Landfill	0	--	Cescos, OH	53,000	0	Offsite	53,000	None	2
Offsite 1B2	10^{-6}	6,710	Landfill	0	--	Cescos, OH	6,710	0	Offsite	6,710	None	1
Attains Requirements 2A	10^{-6}	6,710	Incinerate	6,710	99.99	Onsite	--	0	Onsite	1,677	--	1
Attains Requirements 2B	10^{-6}	6,710	Onsite Landfill	0	--	Onsite	6,710	0	Onsite	2,100	GW	1
Attains Requirements 2C	10^{-6}	0	Multimedia Cap	0	--	Onsite	--	10,060	--	0	GW	1
Exceeds Requirements 3A	<detection	53,000	Onsite Incinerate	53,000	99.99	Onsite	0	0	Onsite	8,555	--	4
Exceeds Requirements 3B	<detection	53,000	Onsite	0	--	Onsite	53,000	0	Onsite	17,500	GW	2
Exceeds Requirements 3C	<detection	0	Multimedia	0	--	Onsite	0	51,200	--	0	GW	1

Table 7 Alternatives-Burning Grounds Area
(Continued)

Alternative	Cleanup Level	Excavated Volume (cy)*	Treatment		Disposal/ Treatment Level (percent)	Disposal		Capped Area (sq yd)	Backfill		Post-Closure Monitoring	Years Mobilized
			Method	Volume (cy)		Site	Volume (cy)		Source	Volume (cy)		
Offsite 1A2	10^{-6}	3,625	Incinerate	3,625	99.99	Enseo, AR	3,625	0	Offsite	3,625	None	1
Offsite 1B1	<detection	17,000	Landfill	0	--	Cescos, OH	17,000	0	Offsite	17,000	None	1
Offsite 1B2	10^{-6}	3,625	Landfill	0	--	Cescos, OH	3,625	0	Offsite	3,625	None	1
Attains Requirements 2A	10^{-6}	3,625	Incinerate	3,425	99.99	Onsite	--	0	Onsite	910	--	1
Attains Requirements 2B	10^{-6}	3,625	Onsite Landfill	0	--	Onsite	3,625	0	Onsite	4,370	GW	1
Attains Requirements 2C	10^{-6}	0	Multimedia Cap	0	--	Onsite	--	5,134	--	0	GW	1
Exceeds Requirements 3A	<detection	17,000	Onsite Incinerate	17,000	99.99	Onsite	0	0	Onsite	3,225	--	2
Exceeds Requirements 3B	<detection	17,000	Onsite Landfill	0	--	Onsite	17,000	0	Onsite	4,600	GW	2
Exceeds Requirements 3C	<detection	0	Multimedia Cap	0	--	Onsite	0	18,556	--	0	GW	1

Table 7 Alternatives-Burning Grounds Area
(Continued)

Alternative	Cleanup Level	Excavated Volume (cy)*	Treatment		Disposal/ Treatment Level (percent)	Disposal		Capped Area (sq yd)	Backfill		Post-Closure Monitoring	Years Mobilized
			Method	Volume (cy)		Site	Volume (cy)		Source	Volume (100)		
CERCLA 4A	10^{-6}	0	Soil Cap	0	--	Onsite	0	5,134	Onsite	0	--	1
No Action 5A	-	--	No Action	--	--	--	--	--	--	--	GW/SW	--

-- = Not Applicable.
GW = Ground Water.
SW = Surface Water.

*All volumes include a swell factor of 25 percent.

Table 7 Alternatives-Industrial Sewerlines
(Continued)

Alternative	Cleanup Level	Excavated Volume (cy)*	Treatment		Disposal/ Treatment Level (percent)	Disposal		Capped Area (sq yd)	Backfill		Post-Closure Monitoring	Years Mobilized
			Method	Volume (cy)		Site	Volume (cy)		Source	Volume (cy)		
Attains Requirements 2A	10^{-6}	20,400	Incinerate	680	95	Onsite	680	0	Onsite	500	--	3
Attains Requirements 2B	10^{-6}	20,400	Flaming/ Onsite Landfill	680	--	Onsite	680	0	Onsite	500	GW	3
Exceeds Requirements 3A	<detection	47,680	Incinerate	29,680	99.99	Onsite	29,680	0	Onsite	8,000	--	3
Exceeds Requirements 3B	<detection	47,680	Flaming/ Onsite Landfill	29,680	--	Onsite	29,680	0	Onsite	9,400	GW	3
CERCLA 4A	10^{-6}	20,400	Flaming/ Backfill	680	--	Onsite	680	0	Onsite	500	--	3
No Action 5A	--	--	No Action	--	--	--	--	--	--	--	GW	--

-- = Not applicable.
GW = Ground Water.

*All Volumes include a swell factor of 25 percent.

RESPONSIVENESS SUMMARY

WEST VIRGINIA ORNANCE WORKS

1. OVERVIEW

To expedite cleanup activities, the West Virginia Ordnance Works Remedial Investigation/Feasibility Study (RI/FS) has been divided into two operable units. The first operable unit consists of the TNT Manufacturing Area, Burning Grounds and Industrial Sewerlines. The remedial alternative recommended by the Army for the first operable unit based on results of detailed Feasibility Study analyses includes: (1) flaming the reactive TNT pieces in place on the surface of the Burning Grounds Area; (2) providing a soil cover over contaminated soils at the TNT Manufacturing Area and Burning Grounds Area; (3) excavating industrial sewerlines, flashing the industrial sewerlines to destroy the contamination, and replacing the flashed material in the excavated trench; and (4) transporting asbestos to an offsite local sanitary landfill for disposal.

This alternative will achieve the remedial response objectives upon implementation. The alternative is recommended to: (1) meet all criteria and requirements established in the Endangerment Assessment; (2) prevent significant adverse impacts to the environment caused by prolonged onsite incineration; and (3) provide viable, cost effective remediation in accordance with the National Contingency Plan.

Based on the comments received at the November 13, 1986 community meeting and the fact that no written comments were received during the public comment period, there seems to be no objection to the recommended alternative as described above.

2. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS

Community interest in the former West Virginia Ordnance Works dates back to 1984, when the Army completed a Records Search into past operations of the former

WVOW now the the McClintic Wildlife Station. Concerns with groundwater quality exist because there are residents living near the industrial area of the former ordnance works. However, groundwater in the TNT Manufacturing Area does not flow towards the residential wells and sampling of all area residential wells indicated that drinking water criteria have not been exceeded.

Congressman Wise's office has requested and received periodic updates from the Army on the environmental work being conducted at the site.

3. SUMMARY OF PUBLIC COMMENTS RECEIVED DURING PUBLIC MEETING

a. Wells

1. Concerns were expressed on drilling new wells into a contaminated area and would a ban be placed on drilling new wells?

Army Response: The first operable unit is located on McClintic Wildlife Station. Groundwater use is already restricted on McClintic. McClintic can only be used for its current use as a wildlife station or the land reverts back to the Federal government. Its use cannot change, it's in the deed.

2. What if Congress changes the law so McClintic could be used for other purposes and the ban was lifted, from a scientific viewpoint, would you recommend a ban so there would be no drilling into the main aquifer?

EPA/Army Response: The study would have to be redone; you've changed the land use. Criteria and objectives developed were based on current land use of McClintic. If land use changes, then the potential alternatives change based on the study performed at that time.

3. Is there anywhere in the U.S. where the method of covering and leaving in place carcinogous materials is done where it is permissible to drill wells into the aquifer?

Army Contractor Response: Yes. There is a Superfund site in Florida with various contaminants that have been left in place with an impermeable cap and

there is a groundwater barrier in the upper aquifer. There are nearby residential wells and no ban on drilling. Monitoring wells have been installed and are being monitored.

4. Are there any wells on McClintic and have they been tested to assure no leaching has occurred and will these wells be capped?

Army Response: There are two wells on McClintic. There is one well we used as the drill water supply; the doghouse well, and that has no contamination in it. We used that well in the drilling process and we analyzed the water and there's no contamination in it. As far as the first operable unit which we're discussing tonight, groundwater in the TNT Manufacturing Area does not flow to the residential wells and is not a problem. Groundwater is not contaminated in the Burning Grounds Area. In regard to capping the wells, they are not in the areas we're reporting on tonight. The groundwater does not flow in that direction.

b. Restoration/Cleanup

1. Is the cleanup standard (10^{-6}), site specific or is the same standard applied at other sites? Would another site have higher concentration values or exposure risks? Would cost guide the choice for cleanup?

EPA Response: When analyzing sites, we try to ensure cleanup levels get to that risk level (10^{-6}). It is conceivable that in some instances there will be certain characteristics of the site where we will not be able to achieve that standard because it is technically impracticable or the cost is so prohibitive that it's not applicable.

Army Response: We're developing criteria for the second operable unit taking into account differences between land use on and off McClintic. How you come into contact with contaminants is very site specific. We are doing endangerment assessments with the same goal, 10^{-6}, for the other areas of the site. It's conceivable a different concentration of nitroaromatics could be developed.

Concentration differences would be dependent upon the land use, the contaminant transport pathways and the potential receptors.

2. If the Army uses capping for the first operable unit, will the Army use the same technology for the second operable unit?

Army Response: The second operable unit concerns include surface waters and groundwater, so there might be different action levels associated with these areas. There are different pathways in the second operable unit. In the first operable unit we are concerned about ingestion of game animals and contact with the skin.

3. What does the Army plan to do about the groundwater?

Army Response: That study will be completed in six months. Tonight we're talking about the source areas.

4. What time schedule will the work be performed under?

Army Response: From the time a Record of Decision is signed, we're expecting that in January, probably three months to get a contractor on board, and we could start field work sometime in the summer. The actions will take about one year to complete.

5. Where will the dirt come from?

Army Response: We think there is suitable soil available on McClintic. The areas to be capped are a total of approximately three acres.

c. Contaminants/Contamination

1. What types of cancer are caused by TNT and its by-products?

Army Response: I don't know. The 10^{-6} is one additional occurence of cancer of any type in one million people with a lifetime exposure.

2. Are TNT and its by-products biodegradeable?

Army Response: Yes. It is a slow process though.

3. Have pollutants reached residential wells?

Army Response: We have sampled residential wells off McClintic and have not found contamination in them.

4. Are there contaminants in the groundwater at the Red Water Reservoir? At the TNT Area?

Army Response: Yes, there is contamination in the shallow aquifer. We don't believe the deep aquifer is contaminated.

d. Costs

1. What are the costs of the studies?

Army Response: We've spent for the RI/FS approximately $1.7 million.

2. Can you break the $1.7 million into portions for each operable unit?

Army Response: Not right off-hand.

3. Will you spend another $1.7 million on the second operable unit?

Army Response: The second operable unit is included in the $1.7 million.

4. REMAINING PUBLIC CONCERNS

The Feasibility Study on the second operable unit will be complete six months following the FS on the first operable unit. Citizens are concerned about their groundwater and what could happen in the six months. Also, a question was asked about flooding that had occured in late winter, early spring 1985 in the Yellow Water Reservoir Area. This same question had been asked by Point Pleasant Mayor Wedge after the Community meeting February 28, 1986. Attached is the response sent to the Mayor, March 18, 1986.

ATTACHMENT A

Community Relations Activities Conducted for the Former WVCW

Community relations conducted for the Former WVCW to date include the following:

- Public Meeting held to discuss upcoming environmental survey (August 1984). News release issued on the survey.

- Fact Sheet prepared and distributed on RI report (February 1986).

- News Release on public meeting and RI issued (February 1986).

- Public Meeting held to discuss RI (February 1986).

- Remedial Investigation Report placed in public repository at Point Pleasant for public review (April 1986).

- Community Relations Plan under development (October 1986).

- Public Repository set up in Charleston, WV (October 1986).

- RI/FS and Endangerment Assessment (EA) sent to public repository in Charleston; FS and EA to Point Pleasant public repository (October 1986).

- Public Comment period (November 3-24, 1986).

- Fact Sheet on first operable unit prepared and distributed (November 1986).

- Public Meeting to discuss FS at first operable unit (November 1986).

STATE OF WEST VIRGINIA
DEPARTMENT OF NATURAL RESOURCES
CHARLESTON 25305

ARCH A. MOORE, JR.
Governor

RONALD R. POTESTA
Director

ROBERT K. PARSONS
Deputy Director

March 17, 1987

Mr. Hector Abreu (3HW12)
U. S. Environmental Protection Agency
Region III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

RE: West Virginia Ordnance
Works, Mason County, WV

Dear Mr. Abreu:

The Enforcement Decision Document for the above referenced site has been reviewed by members of my staff. It is their recommendation that the selected remedy is the preferred option.

Sincerely,

Ronald R. Potesta
Director

RRP/phl/kr

76 1 T

Mr. Turkeltaub/pd/3921

March 18, 1986

Installation Restoration Division

IRD

DIR

IR-R

Mr. Jimmy Joe Wedge
Mayor
City of Point Pleasant
West Virginia 25550

Dear Mr. Wedge:

We have received the enclosed response from our contractor regarding the drainage problem you informed us of at the February 28, 1986, community meeting. I hope the information is helpful to you.

As indicated in his letter, Mr. Kraus would be available to discuss this matter further should you desire a meeting. If you require additional information, please do not hesitate to contact me at (301) 671-3618 or Mr. Robert Turkeltaub at (301) 671-3921.

Sincerely,

Andrew W. Anderson
Chief
Installation Restoration Division

Enclosure

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ESE

ENVIRONMENTAL SCIENCE
AND ENGINEERING, INC.

March 8, 1986
ESE No. 84-604-0700

Commander
U.S. Army Toxic and Hazardous
Materials Agency
ATTN: AMXTH-IR (Mr. R.B. Turkeltaub)
Bldg. E4435
Aberdeen Proving Ground, MD 21010-5401

RE: Contract DAAK11-83-D-0007, Delivery Order 0005
West Virginia Ordnance Works (WVOW) Environmental Survey
Flooding Conditions of February-June 1985 in the Vicinity of the
Yellow Water Reservoir

Dear Mr. Turkeltaub:

This is in response to the public inquiry received during the February 27, 1986, Public Meeting for the above-referenced site at Pt. Pleasant, West Virginia. The inquiry involved the flooding which occurred in the vicinity of the former Yellow Water Reservoir during February through June 1985.

Following a wet fall, the winter of 1984-1985 was quite severe, with extreme low temperatures occurring through most of January 1985. At the end of January when ESE concluded the ground water sampling program, approximately 12 inches of snow remained on the ground. The subfreezing temperatures resulted in substantial ground freeze. During spring thaw, frozen (and saturated) soil will produce higher-than-normal surface runoff and very little, if any, infiltration. This preceding combination of meteorological conditions will frequently produce flooding or ponding conditions in low areas exhibiting poor drainage characteristics.

Based on ESE's field program in the Yellow Water Reservoir area, poor drainage conditions have been observed. During the Archives Search of March 1984 and the Pre-Plan of Study site visit of May 1984, sedges were observed growing in the area. Sedges are a type of wetland plant which typically grows in areas of poor drainage subject to periodic flooding.

I have attached Figure 2.3-6 and Table 2.3-3 of the WVOW Remedial Investigation Report, a map and accompanying data describing the various soil types present at WVOW. The soil type predominant in the Yellow Water Reservoir is the Chilo Sandy Loam, designated ChA. The Chilo is classified as poorly drained and is slowly permeable.

The nature of the soils in the area, coupled with the pattern of precipitation and runoff which occurred during late winter through spring 1985, seems the likely cause of the flooding observed in the subject area. The flooding appears to be in no way related to the ESE field investigation.

As you are aware, the Phase II field program includes field trips scheduled for March 10-23, 1986, and April 14-28, 1986. I will be at the site during these times and would appreciate the opportunity to meet with the parties involved with this property.

Sincerely,

David L. Kraus/KDP

David L. Kraus
Task Manager

DLK:mc

cc: L.J. Bilello
Project Files

Table 2.3-3. Soil Types Within the WOW Site

Soil Type*	Soil Description	Drainage	Permeability
As	Ashton Silt Loam	Well Drained	Moderate-Rapid
ChA	Chilo Sandy Loam	Poorly Drained	Slow
Du	Duncannon Silt Loam	Well Drained	Moderate
GsA	Ginat Silt Loam	Poorly Drained	Very Slow
Ha	Hackers Silt Loam	Well Drained	Moderate
Hu	Huntington Silt Loam	Well Drained	Moderate
La*	Lakin Loamy Fine Sand	Excessively Drained	Rapid
Ma	Markland Silty Clay Loam	Moderately Poorly Drained	Slow-Very Slow
Me	Melvin Silty Clay Loam	Poorly Drained	Moderate Slow-Very Slow
Mg	Monongahela Silt Loam	Moderately Well Drained	Slow
Mo	Moshannon Silt Loam	Well Drained	Moderate
MU	Muskingum-Upshur Silt Loams	—	Moderate
Sc	Sciotoville Silt Loam	Moderately Well Drained	Moderate-Slow
Se	Senecaville Silt Loam	Moderately Well Drained	Moderate-Slow
So	Sloping Land	—	—
Uc	Upshur Clay Loam	Well Drained	Slow-Very Slow
Um	Upshur-Muskingum Clay Loams	—	Slow
Va	Vandalia Clay Loam	Well Drained	Moderate-Slow
Wh	Wheeling Fine Sand Loam	Well Drained	Moderate-Rapid

*See Fig. 2.3-6.
— = Not reported.

Sources: USSCS, 1961.
ESE, 1985.

Cont to end

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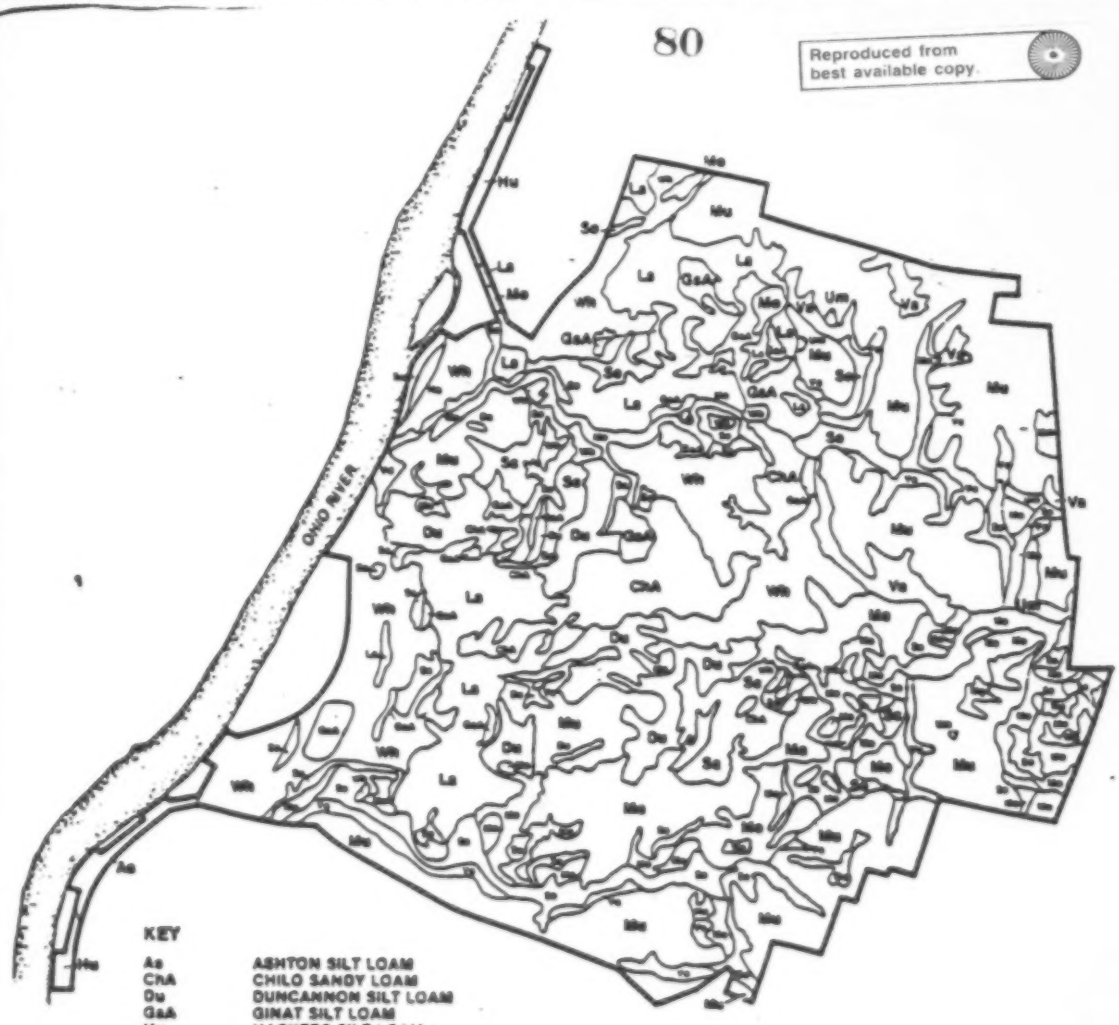

KEY

As	ASHTON SILT LOAM
ChA	CHILO SANDY LOAM
Du	DUNCANNON SILT LOAM
GsA	GINAT SILT LOAM
Ha	HACKERS SILT LOAM
Hu	HUNTINGTON SILT LOAM
La	LAKIN LOAMY FINE SAND
Ma	MARKLAND SILTY CLAY LOAM
Me	MELVIN SILTY CLAY LOAM
Mg	MONONGAHELA SILT LOAM
Mo	MOSHANNON SILT LOAM
Mu	MUSKINGUM-UPSHUR SILT LOAMS
Sc	SCIOTOVILLE SILT LOAM
Se	SENECAVILLE SILT LOAM
Sp	SLOPING LAND
Up	UPSHUR CLAY LOAM
Um	UPSHUR-MUSKINGUM CLAY LOAMS
Va	VANDALIA CLAY LOAM
Wh	WHEELING FINE SAND LOAM

N

NOTE: REFER TO TABLE 2.3-3 FOR FURTHER DETAILS ON SOILS.

SCALE

0.5 0 0.5 1 MILES

0.5 0 0.5 1 KILOMETERS

SOURCES: USSCS, 1961.
ESE, 1985.

Figure 2.3-6
SOILS MAP OF THE
WVOW SITE

WEST VIRGINIA
ORDNANCE WORKS
Remedial Investigation